

BI

SOLUTION



**Business Intelligence II
Group 08**

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State of Iowa
**ALCOHOLIC
BEVERAGES DIVISION**

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BI

01.

INTRODUCTION

Nowadays, companies operate in a VUCA environment – volatile, uncertain, complex, and ambiguous, in which the market is constantly changing. This new reality is also highly competitive, and every point of advantage is needed to make a difference in the consumers' experience and in order to make smart business decisions. Thus, it is absolutely needed that businesses to gather the tools to analyse, respond and plan to improve their strategy in different fields. Here lies the importance of data, the capacity of processing/analysing it into quality information and the need to store it effectively.

Business intelligence makes it possible to leverage software and services, transforming data into business insights that help in strategic and tactical decisions throughout all levels of an organization. Business data is now a part of the company's backbone, and it has become mandatory that we have the ability to collect and retrieve it from all processes of the company, internal or external.

This project embodies a series of strategic actions aimed at extracting the maximum value from data, while also revealing many hidden insights that can substantially improve the decision-making process.

02.

THE COMPANY

2.1. IOWA ALCOHOLIC BEVERAGES DIVISION

The **Iowa Alcoholic Beverages Division (ABD)** is based in the State of Iowa – United States of America and can be defined as an authority for controlling the alcoholic beverage market in the state. It is not only responsible for administrating and enforcing the alcoholic beverage laws in this state but has also **direct control over the distribution** at wholesale of alcoholic liquor to off-premise retailers, maintaining a monopoly in Iowa.

The organization **only** deals with the commercialization of **spirit drinks**, like vodka, gin, whisky, and so on. This means that beer and wine are **out** of the picture in this scenario. The Division facility is located in Ankeny and aims to serve the citizens of Iowa through responsible and efficient licensing, regulation, and distribution of alcohol.

The state of Iowa publishes monthly products and price listings, which contain a price booklet, as well as markups and markdowns. Due to legal reasons, every premise that sells alcohol in bottled form for off-premise consumption is required to hold a special liquor license, and only these selected stores are able to place an order in the online ordering system, which streamlines and simplifies the ordering process. Every alcoholic transaction made is then logged into the commerce system, which is what is going to be analyzed in this project.

ABD not only works as a **mass retailer** of spirit drinks in Iowa but it takes care of all the logistics, such as the **shipping** and **delivery** of the products.



Important note: since the original dataset is composed of more than 3 million rows of transactions, showing weekly liquor sales with multiple information, the group decided to only use a sample of all the information. Between 2018 and 2021, a certain number of monthly (random) transactions were chosen. We chose this format so that the data analysis was more similar to the original population, but it also means that the numbers we are going to analyze are not absolute.

According to the data available, the group was able to take conclusions about some broad aspects of Iowa Alcoholic Beverage Divisons's customers.

As seen in Figure 1, the **revenue** of the company has been demonstrating a pattern of positive **evolution**. Even though between the first three years (2018-2020) the total revenue was slightly the same, there was a notable jump to 2021, where the sales reached the biggest value, around \$862000.

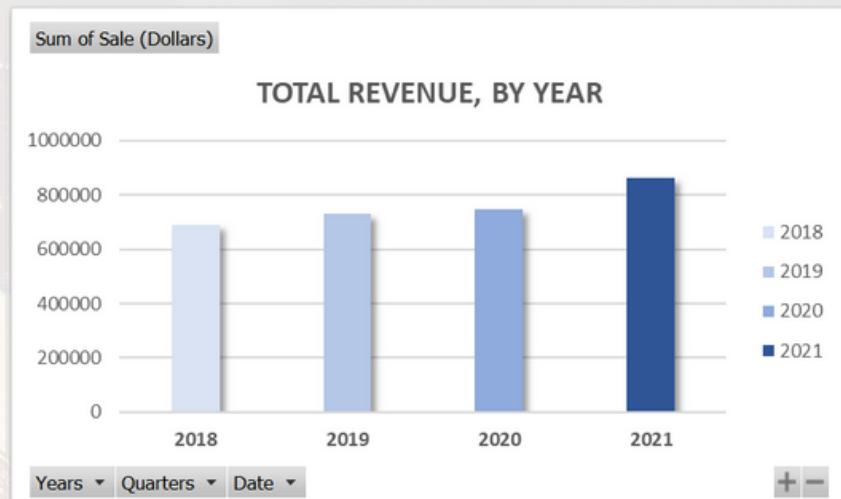


Figure 1 - Total Revenue by Year

Note: Figure 2 shows the Top 10 types of alcohol consumed in Iowa. The percentages are made out of these 10 categories, not from all the categories of the database.

Regarding the **most consumed types of alcohol**, it is quite remarkable that **American Vodkas** and **Canadian Whiskies** stand out from the rest of the categories. Therefore, it is noticed that the origin of each alcoholic beverage is a very important factor for the decision of consumers, since on one hand there are Canadian Whiskeys which take part of almost 20% of the sales of the top 10 categories, and on the other hand there are Tennessee Whiskeys with a very low percentage which goes around 5%.

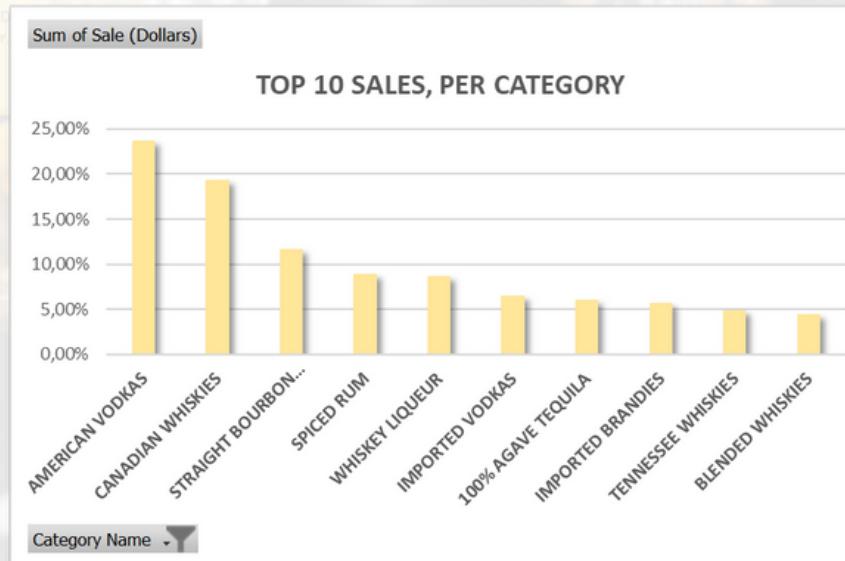


Figure 2 - TOP 10 Sales per Category

Since American Vodkas and Canadian Whiskeys are the main categories of alcohol sold, it is expected that the products which are the most sold are inside of those categories. Therefore, the **product** that stands out the most compared with the rest is **Titos Handmade Vodka**, with a total sales of around \$190000, followed by **Black Velvet** – a Canadian Whiskey.

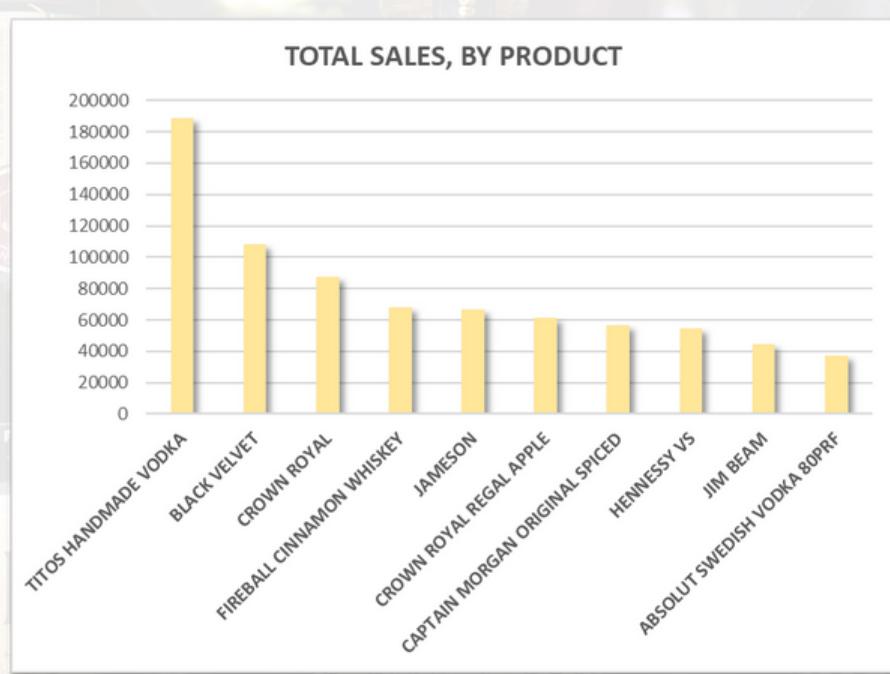


Figure 3 - Total Sales by Product

2.2. PROBLEM SCENARIO

This report analyses a representative sample of the transaction activity of alcohol in the United States, more specifically in the state of Iowa. This sample will be useful to answer several questions, such as: Which cities sell the most alcohol? Which is the most popular brand? How much is sold? Which type of alcohol is more consumed? Among others.

2.3. BUSINESS NEEDS

- 1 Sales Analysis:** To identify the top-selling products and locations and understand which ones are underperforming, it is essential to analyse the sales performance of the Iowa Alcoholic Beverages Division over the past year, including total sales, sales by store location, sales by product category/sub-category and sales trends over time.

The sales amount and quantity measures can be used to provide insights into the store's sales performance.

2

- Vendor Analysis:** From a cost analysis perspective it is crucial to analyse the cost of goods sold by each vendor that supplies the Iowa State. By doing this we are capable of understanding which is our top vendor by category, semester and year.

The measure of cost amount can be used to provide these insights.

3

- Profitability Analysis:** We want to know which products are more and less profitable so that we can analyze if it makes sense to keep selling them. Also, it would be relevant to know which products are ordered the least and analyze their profit, so that we can see if they are worth keeping on the company's portfolio.

It's very relevant to understand if there's a correlation between the top most sold products and the most profitable ones. Analyzing it per year allows us to discover which products are more requested and which ones are maintained as most wanted/profitable and ones that fell on the market, potentially caused by Covid-19.

The measure of profit amount can be used to provide insights into the profitability of the store.

4

- Clients Analysis:** Discover who is our top monthly client in each city, per category/sub-category. This can help us in different ways, like understanding what we are doing well with this client so that we can improve with others. Also, we can propose partnerships and consequently guarantee that we provide the best service to our best clients and maintain a good relationship with them.

To provide these insights we can use the sales amount measure

03.

DATA WAREHOUSE

To design the data warehouse model, we will use the simplest style of a data mart, the **star schema**, which improves performance and has lower query times.

The **dimensional modeling** followed the steps below:

1. Identification of the business process
2. Identification of the grain
3. Identification of the dimensions
4. Identification of the facts

As introduced before, the business process that the data warehouse will represent is the **sales** generated from the purchase orders.

Regarding the grain, **each row represents an individual product purchased by a store from a vendor, and transported by a shipper, on a specific day.**

The business needs mentioned before help identify the measures for the fact table and also which are the dimensions that satisfy our grain.

3.1. MEASURES

In chapter 2, the business of the Alcoholic Beverages Division was described, and the respective business needs were identified. In order to select the measures, those business needs were translated in business questions, as shown in the tables below.

1. Sales Analysis:

BUSINESS QUESTION	MEASURES
1.What are the top 3 products sold by sales quantity and amount per category, county and year?	Sales quantity
2. Which months have the higher sales, per category, per month and per year?	Sales amount
3. Which are the 5 sub-categories with fewer orders, per year?	Sales amount
4. On average, how many products, by quantity, are sold (per year, per category)	Sales quantity
5. What was the impact of covid on the sales growth rate in 2019 to 2020?	Sales amount
6. On AVG what are the sale prices per the Top 5 categories and subcategories, by semester?	Sales amount
7. How does the sales amount compare to the cost amount per product and category, over time?	Sales amount & Cost Amount

Table 1 - Business Questions and Measures of the Sales Analysis Business Need

2. Vendor Analysis:

BUSINESS QUESTION	MEASURES
1. Who are our top 5 vendors, per category, per semester by year?	Cost Amount
2. Who are our 5 vendors with fewer orders, per trimester?	Sales amount
3. Which vendors give us the highest Gross Margin, per Category?	Gross Margin Rate <small>(Calculated Column explained later)</small>

Table 2 - Business Questions and Measures of the Vendor Analysis Business Need

3. Profitability Analysis:

BUSINESS QUESTION	MEASURES
1.What are the top 5 products with higher profit per year?	Profit Amount
2. What is the weight of the top 5 products on the overall profit?	Profit Amount
3. Are the top 20 products with fewer orders profitable, per year?	Profit Amount
4. What categories & subcategories generated more profit over the years, per county?	Profit Amount
5. How did the profit change over the months and years	Profit Amount

Table 3 - Business Questions and Measures of the Profitability Analysis Business Need

4. Clients Analysis:

BUSINESS QUESTION	MEASURES
1. Which store has the highest order values per year?	Sales Amount
2. Who are our top 5 clients, per year?	Sales amount
3. Who are our top 3 clients, per category?	Sales amount

Table 4 - Business Questions and Measures of the Clients Analysis Business Need

MEASURES	FIELD	DESCRIPTION
Sales Quantity	Bottles Sold	-
Sales Amount	Sale (Dollars)	-
Cost Amount	Pack; State Bottle Cost	State Bottle Cost x Pack
Profit Amount	Pack, State Bottle Cost, Sale (Dollars)	[Sale (Dollars)] – [Pack x State Bottle Cost]

Table 5 - Description of the measures and fields that provide them

3.2. DIMENSION TABLES

As mentioned before, dimensions are associated with the fact table. Each dimension table provides descriptive attributes of the fact table.

- **Dim_Vendor Table**

The vendor dimension stores information about the company from which the liquor was ordered.

COLUMN	DATA TYPE	DESCRIPTION
SK_Vendor	Int	Surrogate Key
BK_Vendor	Int	Business Key
Vendor_Name	Nvarchar(100)	Vendor's name that identifies the company brand from where the liquor was ordered
Manager_Name	Nvarchar(100)	Name of the manager of the brand where the liquor was ordered from
Contact_Details	Nvarchar(50)	Phone number of the manager
SCD_Start_Date	Datetime	Start date (record valid from this date)
SCD_End_Date	Datetime	Date of change (record valid until this date)

Table 6 - Vendor Dimension

Type 2 SCD - The managers of the company and associated contact details may change, and the information must be updated accordingly. Even though the possibility is lower, our vendors might suffer changes regarding their code or name of the company (because management might change, company might have been acquired by another, among others).

- **Dim_Product Table**

The product dimension stores information about the liquors ordered and sold by the company.

COLUMN	DATA TYPE	DESCRIPTION
SK_Product	Int	Surrogate Key
BK_Product	Int	Business Key
Item_Description	Nvarchar(100)	Description of the individual liquor product ordered
Category_Code	Int	Category code of the liquor ordered
Category_Name	Nvarchar(100)	Name of the category of the liquor ordered
Sub_Category_Name	Nvarchar(100)	Name of the sub-category of the liquor ordered
Pack	Int	Number of bottles in a case of liquor ordered
Bottle_Volume	Int	Volume of each liquor bottle ordered in ml
State_Bottle_Cost	Decimal (18,2)	The amount that ABD paid for each bottle of liquor ordered
State_Bottle_Retail	Decimal (18,2)	The amount the store paid for each bottle of liquor ordered
SCD_Start_Date	Datetime	Start date (record valid from this date)
SCD_End_Date	Datetime	Date of change (record valid until this date)

Table 7 - Product Dimension

Type 2 SCD - There is a possibility that some characteristics of our products may suffer changes in the future, such as the size of a bottle may change so consequently the volume that it can hold will also change. The prices of the products that were bought and sold may also fluctuate, depending on the market competitiveness and demand.

- **Dim_Store Table**

This table contains the identification of each store and information about its geographic location.

COLUMN	DATA TYPE	DESCRIPTION
SK_Store	Int	Surrogate Key
BK_Store	Int	Business Key
Store_Name	Nvarchar(100)	Name of the store who ordered the liquor
Address	Nvarchar(100)	Address of the store who ordered the liquor
City	Nvarchar(100)	City where the store that ordered the liquor is located
Zip_Code	Int	Zip code of the store that ordered the liquor is located
County_Number	Int	Iowa county number of the county where the store that ordered the liquor is located
County	Nvarchar(100)	County where the store who ordered the liquor is located
SCD_Start_Date	Datetime	Start date (record valid from this date)
SCD_End_Date	Datetime	Date of change (record valid until this date)

Table 8 - Store Dimension

Type 2 SCD - Supposing that a store is reassigned to a different city or county, attributes that provide detail on the geographic location will also change. Since it may be of our interest to see changes in sales according to the location of the store, it's important to store this historical information.

- **Dim_Date Table**

This table contains values of dates with the following granularity: day, month, trimester, semester, and year.

Type 0 SCD - Dimension attributes never change.

COLUMN	DATA TYPE	DESCRIPTION
SK_Date	Int	Surrogate Key
Proper_Date	Date	Date of purchase - 20/12/2021
Full_Date	Nvarchar(50)	20 December 2021
Day_Number	Int	20
Day_Name	Nvarchar(50)	Monday
Month_Number	Int	12
Month_Name	Nvarchar(50)	December
Trimester_Number	Int	4
Trimester_Name	Nvarchar(50)	Trimester 4
Semester_Number	Int	2
Semester_Name	Nvarchar(50)	Semester 2
Year	Int	2021

Table 9 - Date Dimension

- **Dim_Shipping Table**

The shipping dimension stores information about the carriers of the products and the shipping, such as shipping type and shipping class.

COLUMN	DATA TYPE	DESCRIPTION
SK_Shipping	Int	Surrogate Key
BK_Shipping	Int	Business Key
Carrier_Code	Int	Number that identifies the carrier company
Carrier_Name	Nvarchar(100)	Name of the carrier company
Shipping_Category	Nvarchar(100)	Shipping category name
Shipping_Class	Nvarchar(50)	Shipping class name
SCD_Start_Date	Datetime	Start date (record valid from this date)
SCD_End_Date	Datetime	Date of change (record valid until this date)

Table 10 - Shipping Dimension

Type 2 SCD - The carrier code and name might change.

3.3. FACT TABLE

- Fact_Sales Table

This table shows information regarding the sales and profit of our business. It indicates when the purchase done and by which store, which vendor supplied the product to the Alcoholic Beverages Division, what product and category was purchased, who was the shipper and what was the shipping category and class.

COLUMN	DATA TYPE	DESCRIPTION
FK_Date	Int	Foreign Key
FK_Vendor	Int	Foreign Key
FK_Product	Int	Foreign Key
FK_Store	Int	Foreign Key
FK_Shipping	Int	Foreign Key
Sales_Quantity	Int	Number of bottles of liquor ordered by the store
Sales_Amount	Decimal (18,2)	Total sales of liquor order (number of bottles multiplied by the state bottle retail – amount the store paid for the purchase)
Cost_Amount	Decimal (18,2)	Total amount that the Alcoholic Beverages Division paid for each bottle of liquor (Number of bottles multiplied by the state bottle cost)
Profit_Amount	Decimal (18,2)	Profit amount

Table 11 - Sales Fact Table

3.4. HIERARCHIES

A **hierarchy** is a set of levels that represent relationships between different attributes within a hierarchy and have many-to-one relationships between each other.

Product Dimension



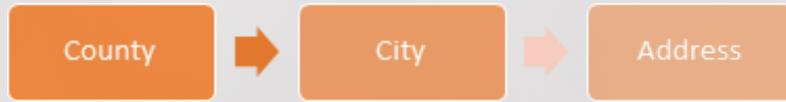
The **product dimension** has three levels of depth. Each item exists in exactly one sub-category, but a sub-category may have many products. The same happens with the category – a category has many sub-categories, but a sub-category only has one category, hence the relationship is “many-to-one.” The level Category and Sub-Category have as attributes the name and code, the level Item has the ID, description, bottle volume and pack.

Date Dimension



The **date dimension** has five levels of depth, with the year as the top level and day as the lowest level of detail. All levels except the year have as attribute the number and name.

Store Dimension



The **store dimension** has three level of depth. The level county has as attributes the county number and name and the level city has the zip code.

Shipping Dimension



The **shipping hierarchy** has two levels, the type being the top level and class the bottom level.

Vendor Dimension



The **vendor** two levels of hierarchy, the company being the top level and the manager responsible for the sector at the bottom level. The attributes of the level Vendor are number and name, and the attributes for the level Manager are name and contact details.

3.5. STAR SCHEMA MODEL

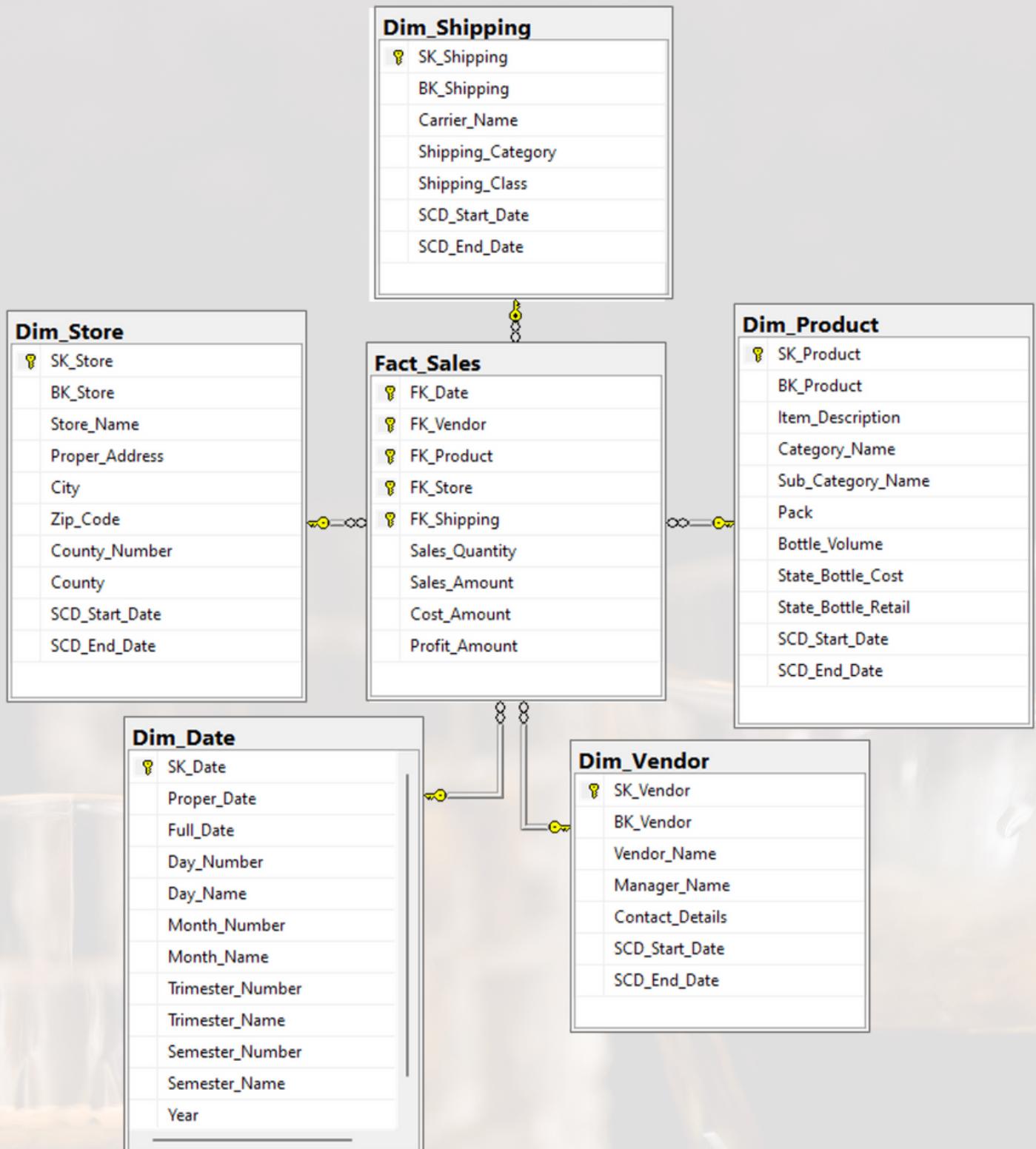


Figure 4 - Star Schema

4. OLAP TABULAR MODEL

4.1. DEVELOPMENT

To enhance reporting flexibility and efficiency, an OLAP tabular model with **hierarchies, measures, and key performance indicators** needs to be created.

The critical components include **dimensions, hierarchies, measures, and KPIs**, which define the characteristics of the data, relationships between the data, the numerical values for analysis, and the performance indicators for evaluating business performance. When creating an OLAP tabular model, it is crucial to consider the data granularity level, depending on the business needs and the required level of analysis.

By creating an OLAP cube, analysts can perform multidimensional analysis, which provides a better understanding of business needs and issues. This, in turn, leads to informed business decisions and better performance evaluation.

First, we started by **creating an Analysis Services Tabular Project** in Visual Studio and **importing the data** from the Data Warehouse previously developed in the first semester. The configuration of our model will be explained in detail in the next topics. However, the overall steps followed are the following:

- First, we started by **checking if all the columns** in the dimensions are relevant to our analysis and decided to **hide some of them**.
- Next, we proceeded with **renaming the remaining columns** so that they are easier to understand. So, for every dimension and fact table, we **capitalise each word and replace the underscore with a space**.
- Then, we double-check the data types and formats of each column and configure them.

4.2. DIMENSIONS

- Product Dimension

As mentioned before, we start by hiding the unnecessary columns from the model, which are both the business and surrogate keys and the columns regarding the slowly-changing dimensions. The figure also shows that the names of the columns have been renamed.

Then we created a Product Hierarchy with a depth of three levels. The highest level is the category and the lowest the Item. This will make it possible to have a deeper understanding of the relationships between different products and categories and ensure that reporting is accurate and efficient.

Dim Product	
SK_Product	
BK_Product	
Item	
Category	
Sub-Category	
Pack	
Bottle Volume	
State Bottle Cost	
State Bottle Retail	
SCD_Start_Date	
SCD_End_Date	
Product Hierarchy	
Category (Category)	
Sub-Category (Sub-C...)	
Item (Item)	

Figure 5 - Dim Product Configuration

The data types and formats of the visible columns were configured as shown below:

COLUMN	DATA TYPE	DATA FORMAT
Item	Text	Text
Category	Text	Text
Sub-Category	Text	Text
Pack	Whole Number	Whole Number
Bottle Volume	Whole Number	Whole Number
State Bottle Cost	Decimal	Currency
State Bottle Retail	Decimal	Currency

Table 12 - Data Types and Formats of Product Dimension

- **Store Dimension**

Like before, we renamed the columns and excluded the business key, surrogate key and the columns regarding the slowly-changing dimensions from our model. It was also decided to exclude County Number as it would not add any relevant information.

Then, the Store Hierarchy was created, having County as the highest level and Address as the lowest level. This will provide us a clear and organised view of store performance at different levels.

Dim Store	
SK_Store	
BK_Store	
Store Name	
Address	
City	
Zip Code	
County Number	
County	
SCD_Start_Date	
SCD_End_Date	
Store Hierarchy	
County (County)	
City (City)	
Address (Address)	

Figure 6 - Dim Store Configuration

The data types and formats of the visible columns were configured as shown below:

COLUMN	DATA TYPE	DATA FORMAT
Store Name	Text	Text
Address	Text	Text
City	Text	Text
Zip Code	Whole Number	Whole Number
County	Text	Text

Table 13 - Data Types and Formats of Store Dimension

- **Vendor Dimension**

Once again, the columns were renamed and the business key, surrogate key and the columns regarding the slowly-changing were excluded.

The vendor has two levels of hierarchy, the company (Vendor Name) being the top level and the manager responsible for the sector at the bottom level.

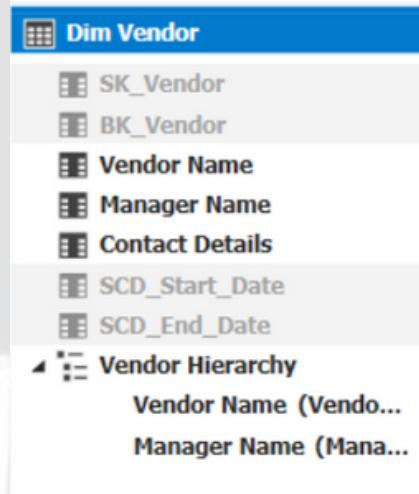
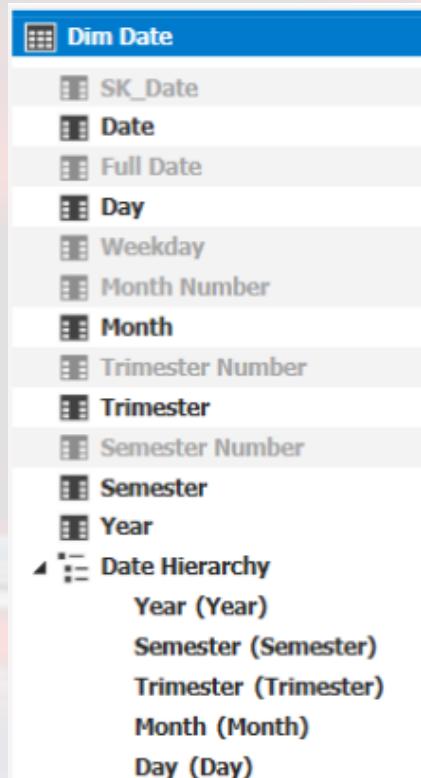


Figure 7 - Dim Vendor Configuration

The data types and formats of the visible columns were configured as shown below:

COLUMN	DATA TYPE	DATA FORMAT
Vendor Name	Text	Text
Manager Name	Text	Text
Contact Details	Text	Text

Table 14 - Data Types and Formats of Vendor Dimension



- **Date Dimension**

The configuration of the date dimension is a bit different than the previous dimensions. We start by renaming all the columns. The most significant difference here is the Business Key Date, previously known as Proper Date.

Then we hid the Surrogate Key from our model. It was also decided that the Month Number, Trimester Number and Semester Number were not relevant since it's more useful to have the respective names. Furthermore, the Full Date and Day (name of the day of the week) were also excluded.

Figure 8 - Dim Date Configuration

Next, we verified if all the columns were properly formatted and **sorted** the Month, Trimester and Semester according to the Number columns so that they appear in the proper order.

We proceed by **checking the data types and formats** of the visible columns and selecting the most appropriate:

COLUMN	DATA TYPE	DATA FORMAT
Date	Date	Short Date
Day	Whole Number	Whole Number
Month	Text	Text
Trimester	Text	Text
Semester	Text	Text
Year	Whole Number	Whole Number

Table 15 - Data Types and Formats of Date Dimension

Finally, we **set the model's Date table** so the system can recognize that this table is the reference for date. We do this by selecting the column Date as a unique identifier for the date table.

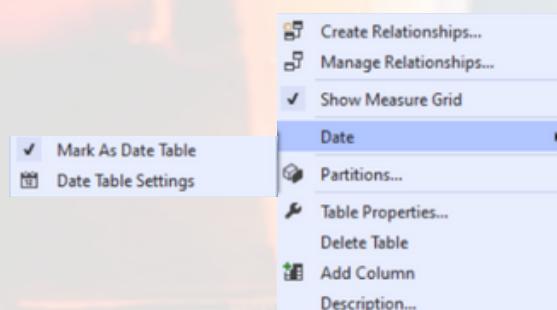


Figure 9 - Model's Date Setup

The last step is the **Hierarchy configuration**. The Date Hierarchy has five levels of depth, with the Year as the top level and Day as the lowest level of detail.

- **Shipping Dimension**

The columns were renamed and the business key, surrogate key and the columns regarding the slowly-changing were excluded.

The Shipping Hierarchy has two levels, the Category being the highest level and the class the lowest level.

Dim Shipping	
SK_Shipping	
BK_Shipping	
Carrier	
Category	
Class	
SCD_Start_Date	
SCD_End_Date	
Shipping Hierarchy	
Category (Category)	
Class (Class)	

Figure 7 - Dim Shipping Configuration

The data types and formats of the visible columns were configured as shown below:

COLUMN	DATA TYPE	DATA FORMAT
Carrier	Text	Yext
Category	Text	Text
Class	Text	Text

Table 16 - Data Types and Formats of Shipping Dimension

4.3. MEASURES

- Fact Sales

First, since the Foreign Keys are not relevant for analysis, we excluded all of them. Then we proceed with the renaming of the columns, following the guidelines mentioned in the beginning.

The Sales Fact Table had the following measures: Sales Quantity, Sales Amount, Cost Amount and Profit Amount. However, in order to be able to answer all our business questions, we proceeded with the creation of a **Calculated Column: Gross Margin Rate**.

```
DAX Editor
✓ ✕ fx
=DIVIDE([Sales Amount]-[Cost Amount], [Sales Amount], 0 )
```

Figure 8 - Dax Formula for Calculated Column

Fact Sales
FK_Date
FK_Vendor
FK_Product
FK_Store
FK_Shipping
Sales Quantity
Sales Amount
Cost Amount
Profit Amount
Gross Margin Rate
Sum of Sales Quantity
Sum of Sales Amount
Sum of Cost Amount
Sum of Profit Amount
Average Sale Price
Sales Growth Rate
Average of Sales Quant...
Gross Margin Percentage
Sales Growth Rate KPI
Gross Margin Percenta...

Figure 9 - Fact Sales Configuration

In the context of a Sales Fact Table, the gross margin rate column will be used to track the profitability of sales transactions. By calculating the gross margin rate for each transaction, we'll identify which products are generating the most profit and make informed decisions regarding our business.

The data types and formats of the measures were configured as shown below:

COLUMN	DATA TYPE	DATA FORMAT
Sales Quantity	Whole Number	Whole Number
Sales Amount	Decimal Number	Currency
Cost Amount	Decimal Number	Currency
Profit Amount	Decimal Number	Currency
Gross Margin Rate	Decimal Number	Percentage

Table 17 - Data Types and Formats of Fact Sales

4.4. CALCULATED MEASURES

Measure	Sum of Sales Quantity
Format	Whole Number
Formula	Sum of Sales Quantity:=SUM([Sales Quantity])

Table 18 - Sum of Sales Quantity configuration

Allow us to know the total **Sum of the Sales Quantity**. This will be useful to analyse the number of products sold in a certain period and compare different products and regions.

Permit us to know the **total sum of the Sales Amount**, which is useful to analyse and compare the revenue generated.

Measure	Sum of Sales Amount
Format	Currency (\$)
Formula	Sum of Sales Amount:=SUM([Sales Amount])

Table 19 - Sum of Sales Amount configuration

Measure	Sum of Cost Amount
Format	Currency (\$)
Formula	Sum of Cost Amount:=SUM([Cost Amount])

Table 20 - Sum of Cost Amount configuration

By doing the **sum of the Cost Amount** values in the table we can analyse the total cost of goods of all the different products.

This measure allows us to understand the **total profit amount** from all the different products, which is useful to determine which products or regions were generating the most profit

Measure	Sum of Profit Amount
Format	Currency (\$)
Formula	Sum of Profit Amount:=SUM([Profit Amount])

Table 21 - Sum of Profit Amount configuration

Measure	Average of Sales Quantity
Format	Whole Number
Formula	Average of Sales Quantity:=AVERAGE([Sales Quantity])

Table 22 - Average of Sales Quantity configuration

With the **Average Sales Quantity**, we were able to calculate the average quantity of products sold per transaction, per customer, or per time period.

Measure	Average Sale Price
Format	Currency (\$)
Formula	Average Sale Price:= DIVIDE([Sum of Sales Amount], [Sum of Sales Quantity], 0)

Table 23 - Average Sale Price configuration

By using this formula, we calculated the **Average Price** that our customers paid for our products.

Measure	Sales Growth Rate
Format	Percentage (%)
Formula	<pre>Sales Growth Rate:= VAR CurrentYearSales = CALCULATE([Sum of Sales Amount], 'Dim Date'[Year] = 2020) VAR PreviousYearSales = CALCULATE([Sum of Sales Amount], 'Dim Date'[Year] = 2019) RETURN DIVIDE(CurrentYearSales - PreviousYearSales, PreviousYearSales)</pre>

Table 24 - Sales Growth Rate configuration

With the **Sales Growth Rate**, we were able to calculate the percentage change in our sales between two years. In the formula, we calculated two variables, CurrentYearSales and PreviousYearSales and then divided the difference between them by the sales of the previous year.

Measure	Gross Margin percentage
Format	Percentage (%)
Formula	Gross Margin Percentage:= DIVIDE([Sum of Sales Amount] - [Sum of Cost Amount], [Sum of Sales Amount], 0)

Table 25 - Gross Margin Percentage configuration

With the **Gross Margin Percentage**, we were capable to understand the gross margin percentage of the sales. The gross margin percentage is crucial to determine the profitability of our business.

4.5. KPI'S

After the creation of our calculated measures, we wanted to measure the progress of the strategies to achieve our business goals, through the **creation of KPIs** (Key Performance Indicators), which will also help us notice if there is a relevant area in the business that needs improving. The period of time that we chose to use for the Sales Growth Rate KPI was between 2019 and 2020, as we thought that it would be interesting to measure **the impact of COVID on our business**.

Our KPIs are:



Figure 10 - Overall KPI

GROSS MARGIN PERCENTAGE KPI

In order to **measure the profitability** of our business, we decided to create our first KPI called Gross Margin Percentage, which is the percentage of product revenue that surpasses our costs.

In this KPI we took the percentage from each of our products and defined that if the percentage was **below 30% (0,3)**, that it was bad and we need to take close attention to those products and try to understand what's causing that in order to change it, for example, a sudden rise of costs; If it was **above 30% and below 60%**, it wasn't good enough for us being our target the **above 60%** of Gross Margin Percentage. A higher Gross Margin Percentage indicates our ability to charge higher prices while lower margins may warn us of rising costs or increased competition. If the value is above 60%, those are the most profitable and we need to make efforts to increase those product sales.

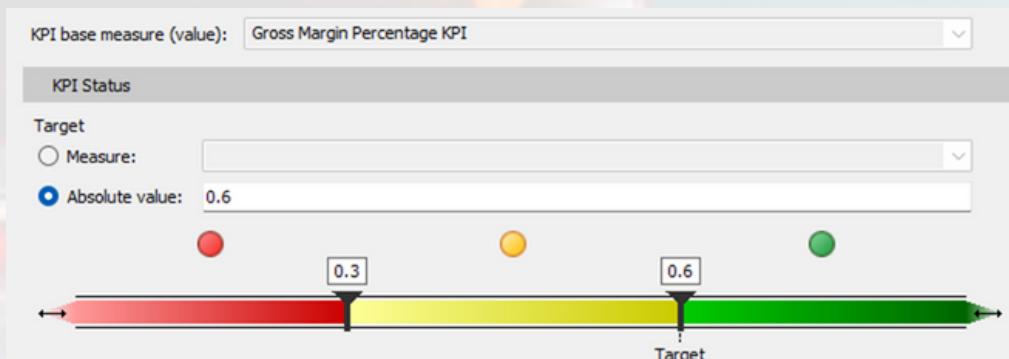


Figure 11 - Gross Margin Percentage KPI Creation

Row Labels	Gross Margin Percentage	Gross Margin Percentage KPI	Gross Margin Percentage KPI Goal	Gross Margin Percentage KPI Status
BRANDY	35.38%	35.38%	60.00%	Yellow
COCKTAIL	38.50%	38.50%	60.00%	Yellow
GIN	35.97%	35.97%	60.00%	Yellow
LIQUEURS	37.26%	37.26%	60.00%	Yellow
RUM	43.75%	43.75%	60.00%	Yellow
SPECIAL	36.26%	36.26%	60.00%	Yellow
SPIRIT	35.28%	35.28%	60.00%	Yellow
TEQUILA	34.54%	34.54%	60.00%	Yellow
VODKA	35.43%	35.43%	60.00%	Yellow
WHISKEY	37.05%	37.05%	60.00%	Yellow
Grand Total	36.96%	36.96%	60.00%	Yellow

Figure 12 - Gross Margin Percentage KPI outcome

As we can see, our Gross Margin percentage is in the yellow zone for most products, and the average Gross Margin Percentage is 36.90%, which means that our products are not underperforming, but they aren't reaching our target goal, which is 60%.

SALES GROWTH RATE KPI

By analyzing the **Sales Growth Rate KPI**, we can **measure the percentage fluctuations in our sales revenue over a specific period of time**. This indicator is also essential as it assists us in observing market trends and strategizing marketing techniques, product placement, and sales approaches. If we get a high value, it indicates that we are getting a surge in demand for our products or expanding the market share, while low or negative values may suggest decreasing demand or challenging competition.

Also, these values need to be compared to the Gross Margin Percentage KPI, because **we can have an outstanding value on the Sales Growth Rate KPI for a specific product, but if the Gross Margin Percentage is very low, that product is not so profitable as we might think**.

Our Value range goes from **below 0%**; **above 0%** and **under 20%**; to the best stage, **20% or above**.

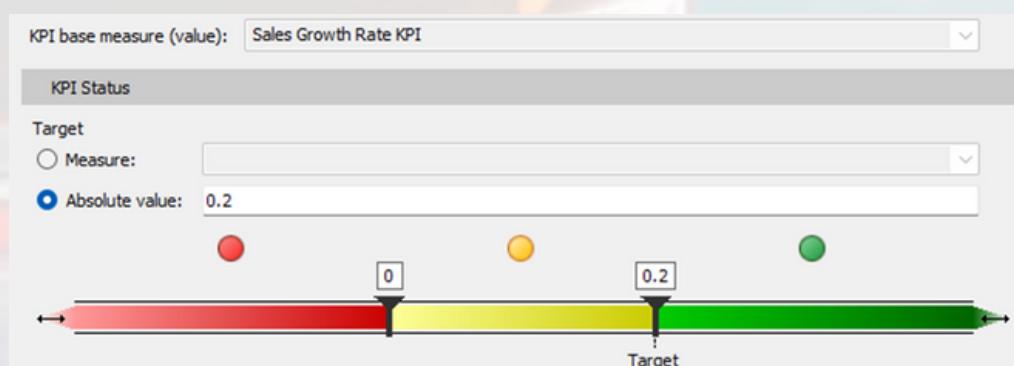


Figure 13 - Sales Growth Rate KPI Creation

Row Labels	Sum of Sales Amount	Sales Growth Rate KPI	Sales Growth Rate KPI Goal	Sales Growth Rate KPI Status
+	\$455.00	-100.00%	20.00%	Red
⊕ BRANDY	\$150,658.00	-40.62%	20.00%	Red
⊕ COCKTAIL	\$63,625.00	-91.76%	20.00%	Red
⊕ GIN	\$73,547.00	-75.53%	20.00%	Red
⊕ LIQUEURS	\$210,428.00	-49.70%	20.00%	Red
⊕ RUM	\$321,331.00	-81.70%	20.00%	Red
⊕ SPECIAL	\$88,996.00	-56.44%	20.00%	Red
⊕ SPIRIT	\$27,814.00	-71.04%	20.00%	Red
⊕ TEQUILA	\$184,532.00	-57.60%	20.00%	Red
⊕ VODKA	\$786,729.00	-73.73%	20.00%	Red
⊕ WHISKEY	\$1,115,066.00	-65.62%	20.00%	Red
Grand Total	\$3,023,181.00	-68.34%	20.00%	Red

Figure 14 - Sales Growth KPI outcome

In this case, we can see that our Sales Growth Rate KPI values are at the **worst range** of this KPI, warning us that we got a serious decrease in all of our product sales. As a result of this KPI, we came to the conclusion, that **COVID had a major impact** on our business, so we need to strategize solutions to help us change this scenario.

4.6. PERSPECTIVES

A perspective is a subset of the features of a cube. The great advantage of using perspectives is to present specific and customised content to a particular group of users. This enables us to interact only with smaller parts of the model and satisfy our reporting requirements.

Beyond the full view, which exposes an overview of all data, we set two different perspectives of our model:

- **Vendor management perspective** - we selected data, dimensions, measures and KPIs regarding vendor and product
- **Client management perspective** - we selected data, dimensions, measures and KPIs regarding store, shipping and product.

The detailed configuration of each perspective can be seen in the figure below.

Fields	Clients Management Perspective	Vendor Management Perspective
- Tables	-	-
- CalculationGroup 1	<input type="checkbox"/>	<input type="checkbox"/>
CalculationItemColumn 1	<input type="checkbox"/>	<input type="checkbox"/>
+ Dim Date	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
+ Dim Product	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
+ Dim Shipping	<input checked="" type="checkbox"/>	<input type="checkbox"/>
+ Dim Store	<input checked="" type="checkbox"/>	<input type="checkbox"/>
+ Dim Vendor	<input type="checkbox"/>	<input checked="" type="checkbox"/>
- Fact Sales	-	-
Cost Amount	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FK_Date *	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FK_Product *	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FK_Shipping *	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FK_Store *	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FK_Vendor *	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Gross Margin Rate	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Profit Amount	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Sales Amount	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Sales Quantity	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Average of Sales Quantity	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Average Sale Price	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Gross Margin Percentage	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sales Growth Rate	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sum of Cost Amount	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sum of Profit Amount	<input type="checkbox"/>	<input type="checkbox"/>
Sum of Sales Amount	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Sum of Sales Quantity	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Gross Margin Percentage KPI	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sales Growth Rate KPI	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Figure 15 - Perspective Configuration

4.7. ROLES

OLAP cube roles are an important tool for controlling access to sensitive data and ensuring that users can only see the data they are authorised to see. We created **10 roles**, one for each **product category**, as we assume that there is a specialized person for each type of product.

The screenshot shows the 'Role Manager' dialog box. It contains a table with three columns: 'Name', 'Permissions', and 'Description'. The roles listed are Brandy Analyst, Cocktail Analyst, Gin Analyst, Liqueurs Analyst, Rum Analyst, Special Analyst, Spirit Analyst, Tequila Analyst, Vodka Analyst, and Whiskey Analyst. All roles have 'Read' permissions. The 'Tequila Analyst' row is highlighted with a blue background.

Name	Permissions	Description
Brandy Analyst	Read	Person who analysis Brandy category.
Cocktail Analyst	Read	Person who analysis Cocktail category.
Gin Analyst	Read	Person who analysis Gin category.
Liqueurs Analyst	Read	Person who analysis Liqueurs category.
Rum Analyst	Read	Person who analysis Rum category.
Special Analyst	Read	Person who analysis Special category.
Spirit Analyst	Read	Person who analysis Spirit category.
Tequila Analyst	Read	Person who analysis Tequila category.
Vodka Analyst	Read	Person who analysis Vodka category.
Whiskey Analyst	Read	Person who analysis Whiskey category.

Figure 16 - Role Specification

To filter information regarding each product category, we created the DAX (Data Analysis Expressions) formula, as shown in the table below, for all product categories. In this way, **each product analyst will only have access to the information of the products in this category**.

The screenshot shows the 'Row Filters' dialog box. It has tabs for 'Row Filters', 'Members', and 'Tables and Columns'. The 'Tables and Columns' tab is selected. It displays a table with two columns: 'Table' and 'DAX Filter'. The 'Fact Sales' table is selected. The 'Dim Product' table has a DAX filter applied: `= 'Dim Product'[Category] = "LIQUEURS"`. Other tables like Dim Date, Dim Shipping, Dim Store, and Dim Vendor have no filters applied.

Table	DAX Filter
Fact Sales	
Dim Date	
Dim Product	= 'Dim Product'[Category] = "LIQUEURS"
Dim Shipping	
Dim Store	
Dim Vendor	

Figure 17 - Dax Formula for Product Category

The screenshot shows the 'Tables and Columns' dialog box. It has tabs for 'Row Filters', 'Members', and 'Tables and Columns'. The 'Tables and Columns' tab is selected. It displays a list of tables: Fact Sales, Dim Date, Dim Product, Dim Shipping, Dim Store, and Dim Vendor. Next to each table is a checkbox labeled 'Visible'. Only the 'Dim Shipping' checkbox is checked, while the others are unchecked.

Table	Visible
Fact Sales	<input type="checkbox"/>
Dim Date	<input type="checkbox"/>
Dim Product	<input type="checkbox"/>
Dim Shipping	<input checked="" type="checkbox"/>
Dim Store	<input type="checkbox"/>
Dim Vendor	<input type="checkbox"/>

Figure 18 - Selection of not visible columns

We also considered that the information in the **Dim Shipping table was of no interest for this analysis**, so we decided to hide it from the users.

4.8. OLAP TABULAR MODEL SCHEMA

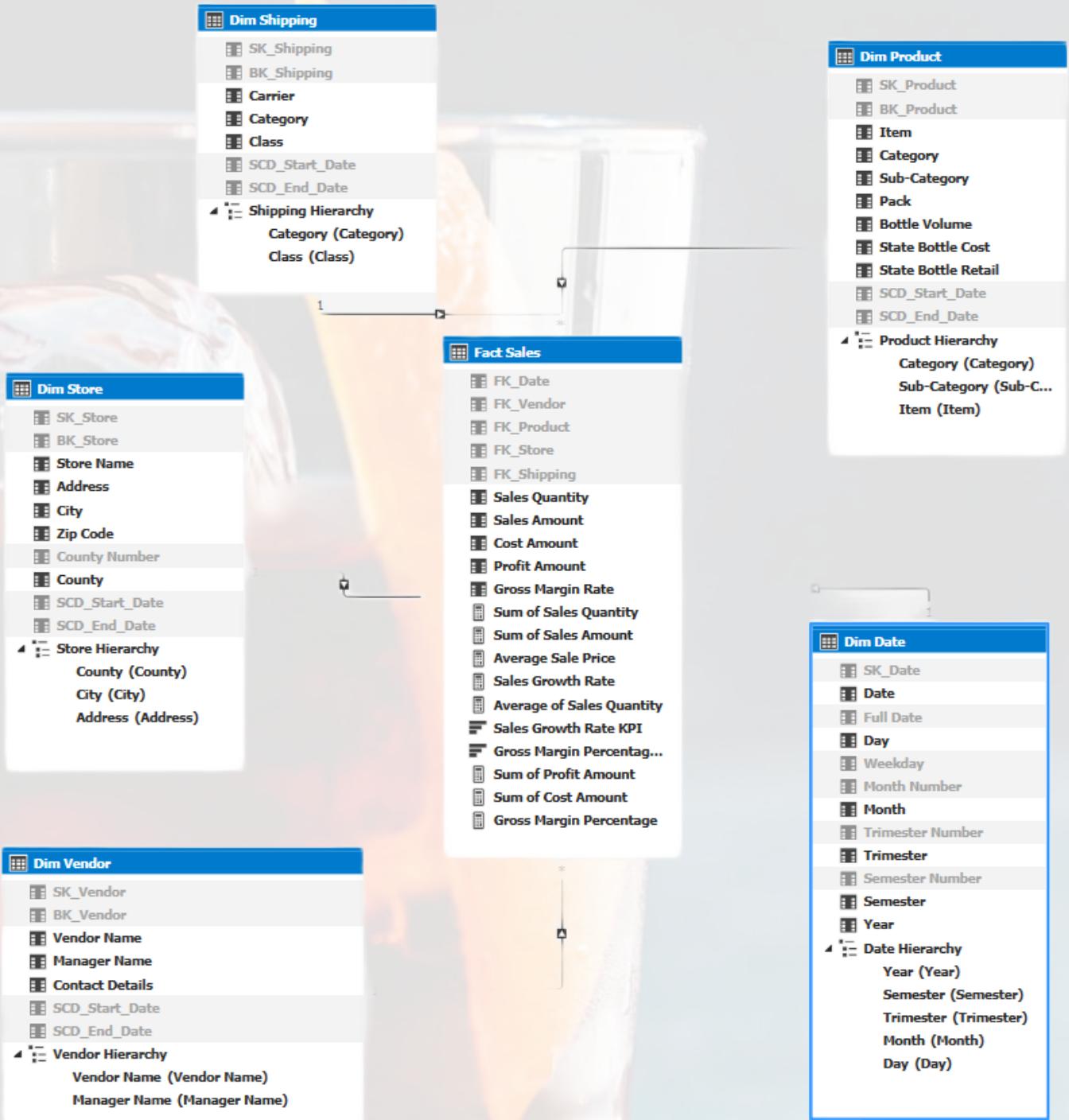


Figure 19 - OLAP Tabular Model Schema

5. REPORTING & DASHBOARDING

To effectively address the various reporting needs of our organization, we implemented multiple reporting solutions and dashboards. Here is an overview of the reporting solutions we have developed:

- **SQL Server Reporting Services (SSRS)**

We created two tabular reports and one matrix report using SSRS. These reports leverage the power of SQL Server and present data in a structured and organized way. Each report is designed to meet specific requirements.

- **Excel pivot table linked to SSAS**

For the purpose of providing further in-depth analysis and multidimensional reporting, we have developed an Excel pivot table connected to SQL Server Analysis Services (SSAS). As such, we can explore data from a multidimensional perspective and use the slice and dice gain valuable insights.

- **Power BI Solutions**

We have also developed two distinct solutions using Microsoft Power BI, each addressing all business needs. Power BI provides stakeholders the possibility to interactively explore data and gain timely insights.

1. DirectQuery for OLAP Tabular Model

The first solution uses the DirectQuery to connect directly to the OLAP Tabular Model. This approach provides real-time access to data and allows dynamic analysis. This solution consists of four pages, each specifically designed to address a business need and provide answers to related business questions.

2. Import the data from the Data Warehouse

Our second Power BI solution involves importing data from the Data Warehouse into Power BI. It also consists of four pages, with each one tailored to meet a specific business need and provide answers to related business questions.

By distributing the business questions over the various reports and solutions, we guarantee that each report addresses unique aspects and provides distinct information.

5.1. SSRS TABLE REPORTS

We exported the data from SSAS to an SSRS report to present our data in a structured and organized manner, enabling us to analyze, summarize, and make informed decisions based on the displayed information. We then analyzed two tables reports.

- The **Sales Analysis table report** showed us what are the **Top 3 Products by Sales Quantity and Amount per Category, County and Year**.
- The **Profitability Analysis table report** shows us which are the **top 20 products with fewer orders profitable, per year**.

Sales Analysis - Top 3 Products by Sales Quantity and Amount per Category, County and Year			
Category	Item	Sales Quantity	Sales Amount
WHISKEY	BLACK VELVET	10,389	\$108,295.00
	FIREBALL CINNAMON WHISKEY	4,911	\$54,914.00
	CROWN ROYAL REGAL APPLE	2,764	\$61,410.00
VODKA	TITOS HANDMADE VODKA	9,802	\$188,625.00
	HAWKEYE VODKA	6,126	\$38,134.00
	MCCORMICK VODKA PET	4,083	\$15,513.00
TEQUILA	JOSE CUERVO ESPECIAL REPOSADO TEQUILA	1,358	\$21,848.00
	JOSE CUERVO ESPECIAL SILVER	728	\$11,042.00
	MONTEZUMA GOLD TEQUILA	647	\$6,808.00
SPIRIT	JUAREZ GOLD DSS	960	\$7,203.00
	EVERCLEAR ALCOHOL	282	\$3,855.00
	TORTILLA GOLD DSS	156	\$1,135.00
SPECIAL		4,226	\$88,996.00

Figure 20 - Sales Analysis Table Report

This first table, like we previously mentioned, was directed to the Sales Analysis business need, more specifically the question **“What are the Top 3 Products by Sales Quantity and Amount per Category, County and Year”**.

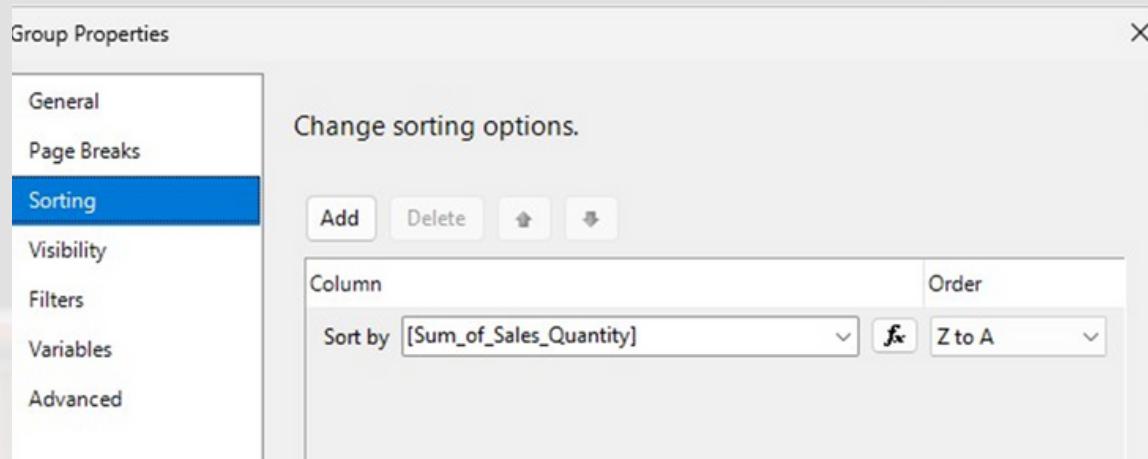


Figure 21 - Sort By command

We sorted the Sum_of_Sales_Quantity in a descending order to give us the top products by quantity.

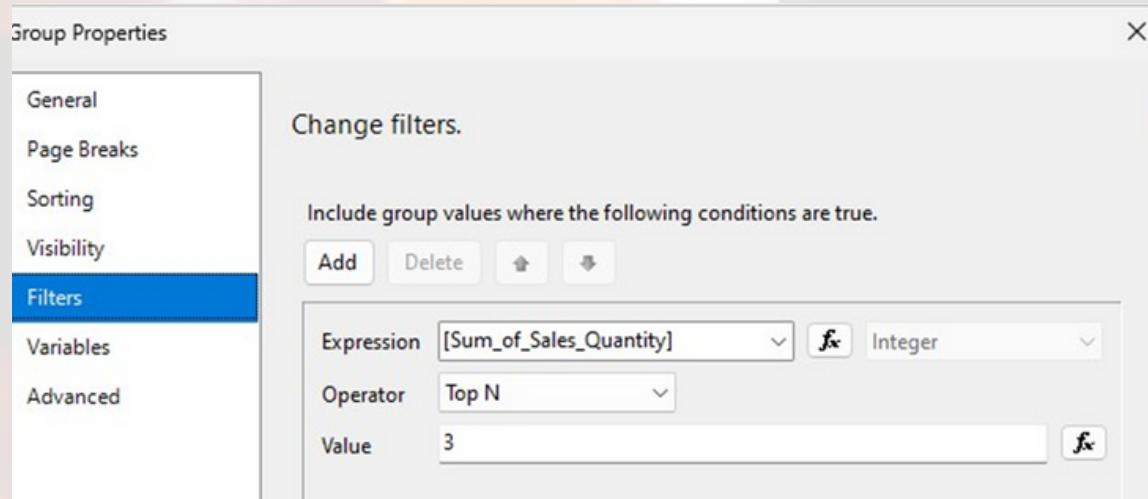


Figure 22 - Filters used

As we wanted the top 3 biggest sales products, we used the filter option to select only the Top 3 products with the highest Sales Quantity.

Since the items are grouped by category, we can see the top 3 items in each one of the categories in our dataset. To allow the analysis per year and county, we added two parameters to enable the option of year and county selection:

Year All

County All

Figure 23 - Parameters used

Creating this report allows us to get insights into product performance by category, and geographic location and explore trends across different time periods. Overall, this analysis improves decision-making processes and drives growth for the future.

Profitability Analysis - 20 Products with fewer orders per year

Item	Category	Sum of Sales Quantity	Sum of Profit Amount
MALIBU COCONUT RUM	RUM	2,041	\$11,305.00
ADMIRAL NELSON SPICED RUM	RUM	2,151	\$9,438.00
BACARDI SUPERIOR RUM	RUM	2,297	\$12,467.00
FIREBALL CINNAMON WHISKY	WHISKEY	2,342	\$7,026.00
CROWN ROYAL CANADIAN WHISKY	WHISKEY	2,407	\$25,519.00
ABSOLUT SWEDISH VODKA 80 PRF	VODKA	2,513	\$14,934.00
JAMESON	WHISKEY	2,559	\$25,300.00
JIM BEAM	WHISKEY	2,677	\$16,490.00
CROWN ROYAL REGAL APPLE	WHISKEY	2,764	\$22,557.00
HENNESSY VS	BRANDY	2,872	\$15,035.00
MCCORMICK VODKA	VODKA	2,876	\$3,207.00
SMIRNOFF 80PRF	VODKA	2,939	\$12,418.00
FIVE O'CLOCK VODKA	VODKA	3,613	\$7,789.00
CAPTAIN MORGAN SPICED RUM	RUM	3,666	\$21,104.00
MCCORMICK VODKA PET	VODKA	4,083	\$8,190.00
FIREBALL CINNAMON WHISKEY	WHISKEY	4,911	\$19,794.00
HAWKEYE VODKA	VODKA	6,126	\$14,870.00
TITOS HANDMADE VODKA	VODKA	9,802	\$67,988.00
BLACK VELVET	WHISKEY	10,389	\$39,765.00
FIREBALL CINNAMON	LIQUEURS	14,537	\$19,564.00

Figure 24 - Profitability Analysis Table Report

This second table report focuses on the **Profitability Analysis**, more specifically the question “**What are the Top 20 Products with fewer orders per year**”.

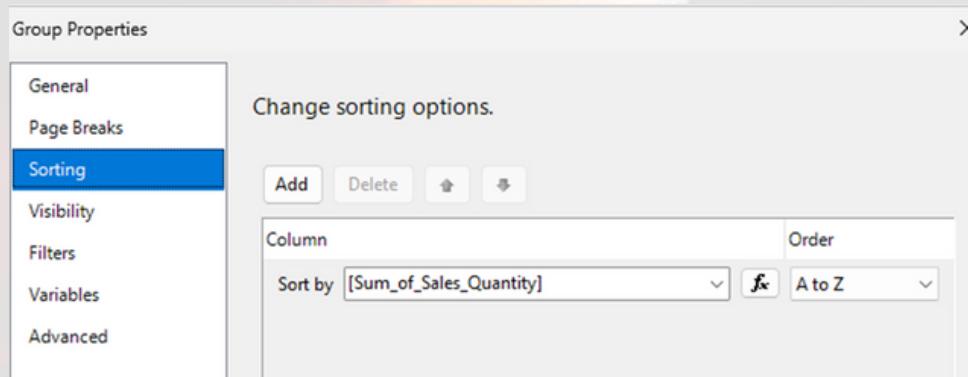


Figure 25 - Sort By command

We sorted the Sum_of_Sales_Quantity in ascending order to give us the top products by quantity.

This analysis helps us identify underperforming products and understand customer behaviour and preferences.

5.2. SSRS MATRIX REPORT

In order to have a better understanding of our costs with the products that we buy from the vendors, we chose to use this matrix report as a visualization tool to efficiently analyze our **Top 5 Vendors, per category, per semester and by year**.

Top Vendors per Category		Semester 1	Semester 2
WHISKEY	DIAGEO AMERICAS	\$59,621.00	\$104,597.00
	SAZERAC COMPANY INC	\$47,339.00	\$77,891.00
	JIM BEAM BRANDS	\$33,216.00	\$59,079.00
	BROWN FORMAN CORP.	\$32,535.00	\$35,601.00
	HEAVEN HILL BRANDS	\$16,479.00	\$39,530.00
VODKA	DIAGEO AMERICAS	\$34,132.00	\$37,991.00
	FIFTH GENERATION INC	\$23,931.00	\$98,074.00
	PERNOD RICARD USA	\$15,217.00	\$26,006.00
	PHILLIPS BEVERAGE	\$8,998.00	\$14,887.00
	LUXCO INC	\$8,408.00	\$24,666.00
TEQUILA	PROXIMO	\$14,576.00	\$17,242.00
	DIAGEO AMERICAS	\$8,377.00	\$5,800.00
	BACARDI USA INC	\$7,326.00	\$2,224.00
	PATRON SPIRITS COMPANY	\$5,559.00	\$5,852.00

Figure 26 - Vendor Analysis Matrix Report

We utilized the report wizard to build the matrix and used the measure Sum of Cost Amount (that was previously calculated) which gave us a view of our total costs. We grouped the vendors by category and using the Sum of Cost Amount measure we sorted them from Z to A, meaning that the vendors with higher cost amounts are on the top:

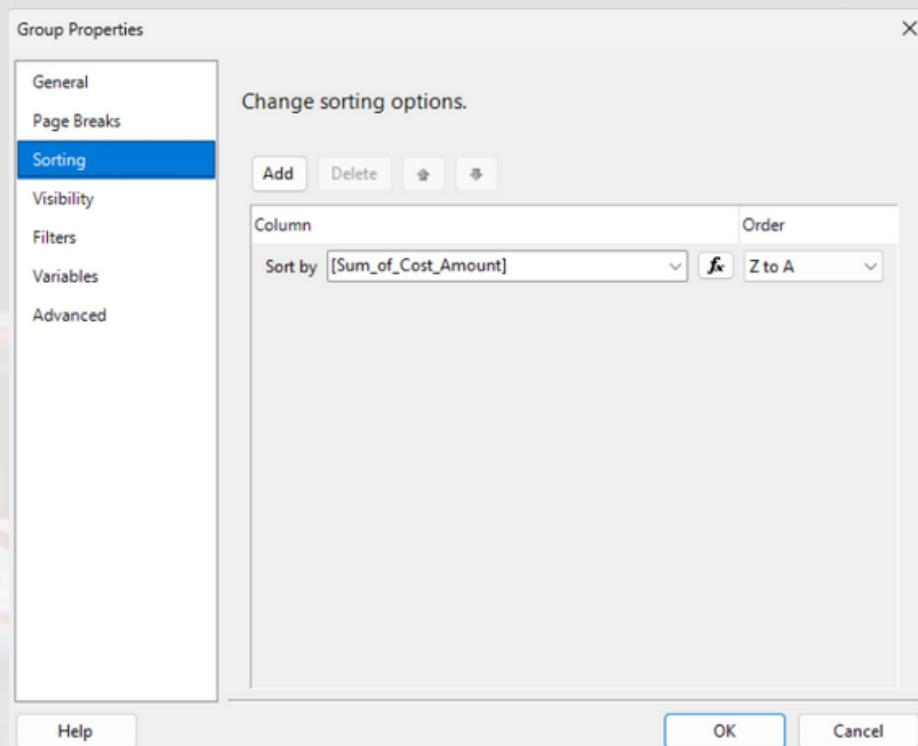


Figure 27 - Sort by Command

Then, since our need is to know which are the top 5 vendors, we used a filter that enabled us to select only the 5 top vendors based on the sum of cost amount:

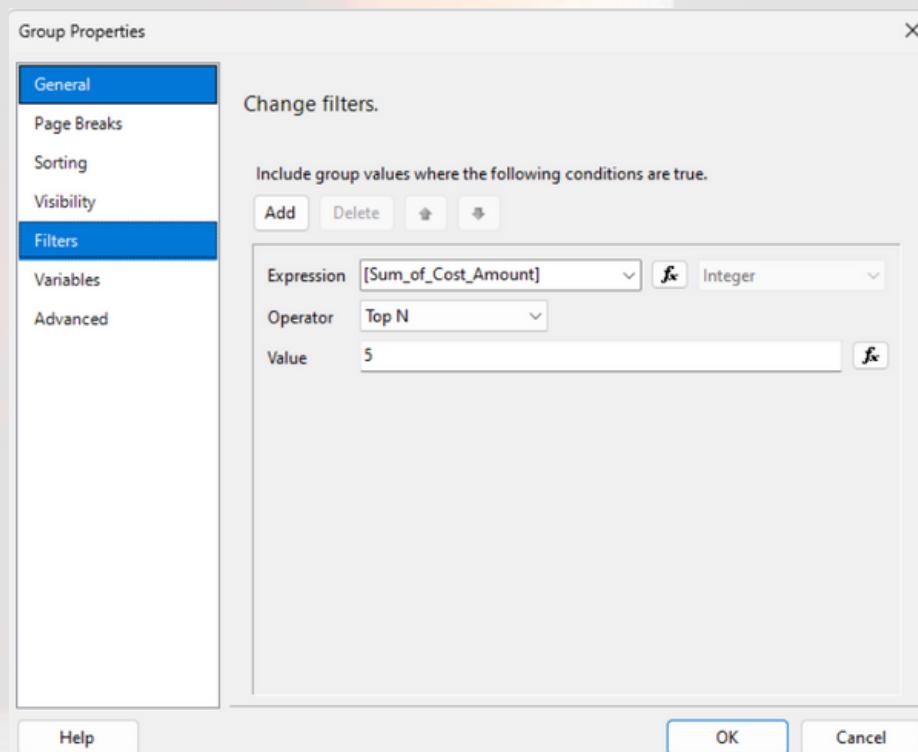


Figure 28 - Filters used

We also want to be able to make a yearly analysis, so we added "Year" as a parameter in order to allow the user to choose the time period that he wants to analyse:

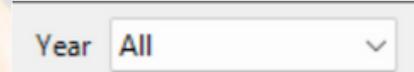


Figure 29 - Parameters used

With this matrix, we are successfully providing information regarding vendor performance which allows us to find opportunities for strategic partnerships and improve relationships.

5.3. EXCEL PIVOT TABLE REPORT

We exported the data that we had in SSAS, directly to Excel in order to create a pivot table that we could easily customize. As mentioned in the **Client Analysis Business Need**, we wanted to know **which store has the highest order values, per Year**, so we used the Date hierarchy to drill down the date per year, all the way until the month (we also made available the semesters per further analysis purposes).

Figure 30 - Excel Pivot Table Report

To get the full number of orders by store, we used the Store Dimension, more specifically the Store name (in the rows) and we also used the drill-down method, to easily identify the total Sales Quantity store and year.

We can understand which location has the most profitable stores, which could be a good insight into what is working best to improve the store performance and to rethink marketing strategies for underperforming stores based on the best practices applied to the top stores.

5.4. POWER BI SOLUTIONS

SOLUTION 1

This solution is based on DirectQuery (Live Connection) to the OLAP Tabular Model.

In this solution, **all the data requirements have already been done in the OLAP Tabular Model**. So, all the tables are already correctly named, the needed columns are hidden and the hierarchies, calculated columns, calculated measures, KPIs are already created.

To answer our business questions, we still needed to create new measures:

- **Average Profit:**

```
Average Profit = AVERAGE('Fact Sales'[Profit Amount])
```

- **Average Sales Amount**

```
Average Sales Amount = AVERAGE('Fact Sales'[Sales Amount])
```

The main purpose of this solution is the creation of a dashboard on the Report View. Below, we will explain each page of the solution and answer specific business needs and questions in each.

BN1 | SALES ANALYSIS

The "Sales Analysis: Sub-category, Quantity and Covid-19 Impact" answers the business questions below regarding the business need Sales Analysis.

- 1 Which are the 5 sub-categories with the fewer orders, per year?**
- 2 On AVG how many products, by quantity, are sold (per year, per category)**
- 3 What was the impact of Covid on the sales growth rate, in 2019 to 2020?**

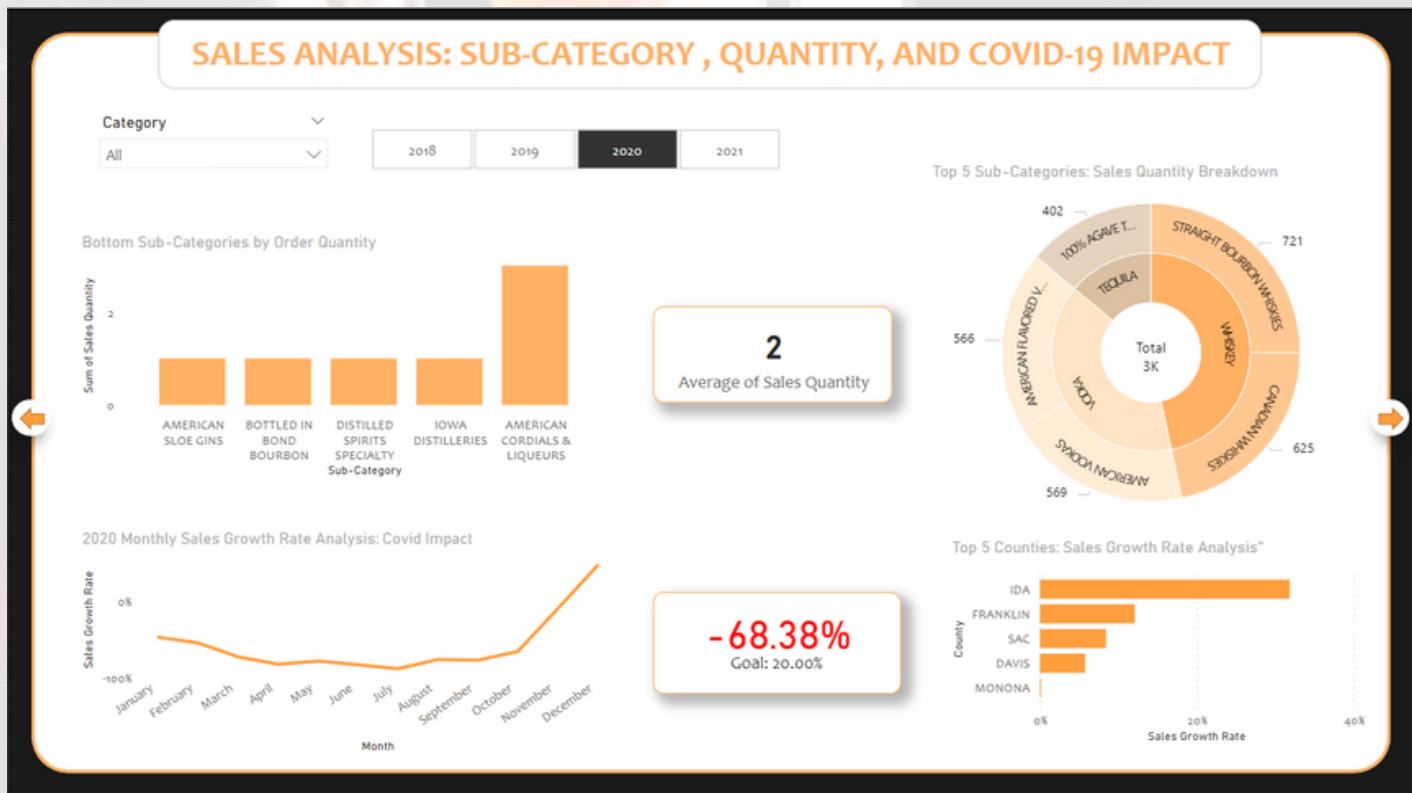


Figure 31 - Solution 1: BN1 Sales Analysis

To effectively answer our business questions, the following visualizations were used:

- First, we incorporated **slicers for category and year selection**, which allows interactive analysis.
- The **stacked column chart** shows which sub-categories have the lowest orders by quantity and the **card** highlights the average quantity of products sold per year and category. In contrast, the **Sunburst Chart by MAQ software has been imported** to display the top 5 sub-categories and respective categories, also by sales quantity.
- To understand the impact of Covid-19 on the sales growth rate in 2020, the **Line chart** has been used. Additionally, the **stacked bar chart** displays the top 5 counties that had the highest growth rate, in the period between 2019 and 2020.
- Finally, a sales growth rate **KPI visualization** was incorporated with the goal of enabling stakeholders to easily monitor the sales performance. As mentioned in the KPI section, the target is to achieve 20% or above of sales growth., something that clearly was not achieved.

These analysis provide insights regarding demand and what sub-categories need intervention and strategies for improvement.

Additionally, by understanding the trends on the sales growth, we can understand if there is a need to adapt strategies or implement new ones to mitigate future risks that could impact our business.

BN2 | VENDOR ANALYSIS

The "Top Vendors by Gross Margin: Category and Year Analysis" answers the business question below regarding the business need for Vendor Analysis:

- Which vendors give us the highest Gross Margin, per Category, per year?

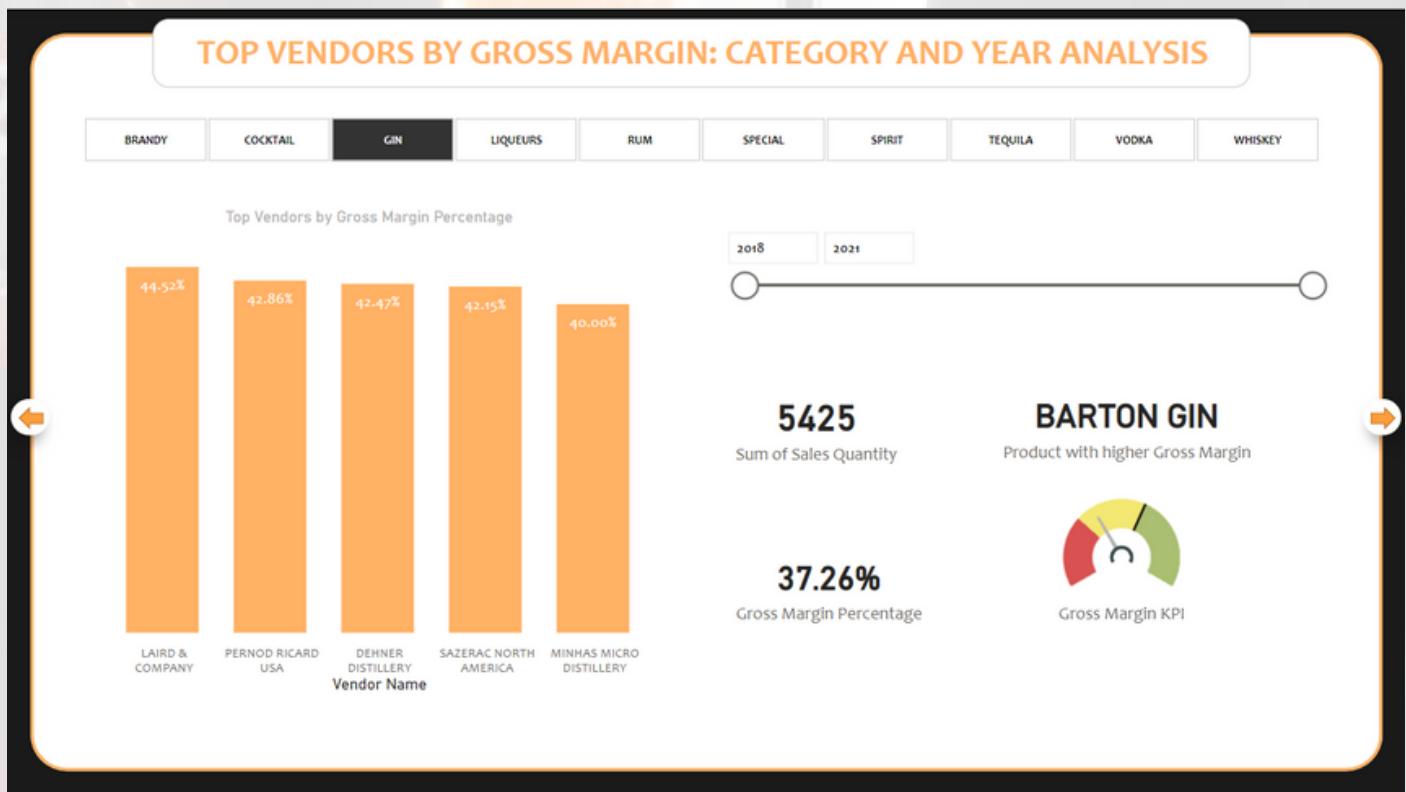


Figure 32 - Solution 1: BN2 Vendor Analysis

To answer the question above, the following visualizations were used:

- First, we added **slicers** to select the year and category, enabling us to filter the information.

- In order to visualize the top 5 vendors with the highest gross margin percentage we used a **stacked column chart**. This allows a quick identification of the essential vendors of our business since they provide the products with higher gross margin, which results in increased profitability.
- Additionally, the use of multiple **card** visualizations highlights key metrics for each vendor.
- Lastly, we **imported the Tachometer visualization to display our KPI** performance related to the Gross Margin Percentage provided by each vendor. This visualization is an easy way for stakeholders to monitor progress and see if a specific vendor has reached the target value (which is above 60%).

By knowing which vendors offer the most profitable products by category and year, we can make data-driven decisions to improve profitability and vendor relationships.

BN3 | PROFITABILITY ANALYSIS

The "Profitability Analysis: Categories and Subcategories by County" answers the business question below regarding the business need Profitability Analysis:

- **What categories & subcategories generated more profit over the years, per county?**

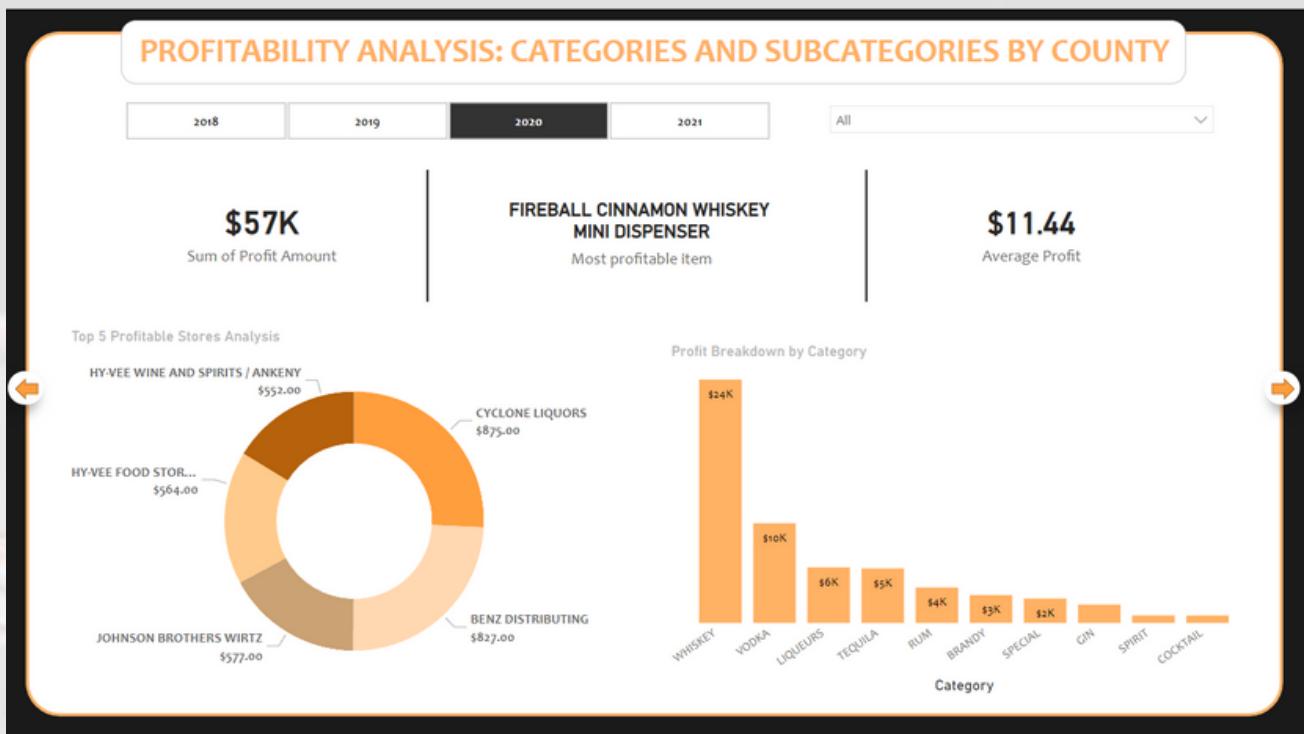


Figure 33 - Solution 1: BN3 Profitability Analysis

For this purpose, we incorporated:

- **Slicers** to filter by Year and County
- **Donut Chart** to display the top 5 most profitable stores in each county, in other words, the clients that provide the highest profit to us by county.
- The **stacked column chart** represents the profit generated by category, making it clear which category of products is the most profitable.
- The **cards** used display essential metrics for this analysis, such as the total profit amount, most profitable item and the average profit.

These visualizations allow us to understand which product categories are the most profitable across store and county. By knowing this information it's possible to make strategic decisions regarding our product portfolio and understand our customers by region. Ultimately, this will lead to an increase of our overall productivity.

BN4 | CLIENTS ANALYSIS

The "Client Analysis: Top 5 clients by Year" answers the business question below regarding the business need Clients Analysis:

- Who are our top 5 clients, per year ?

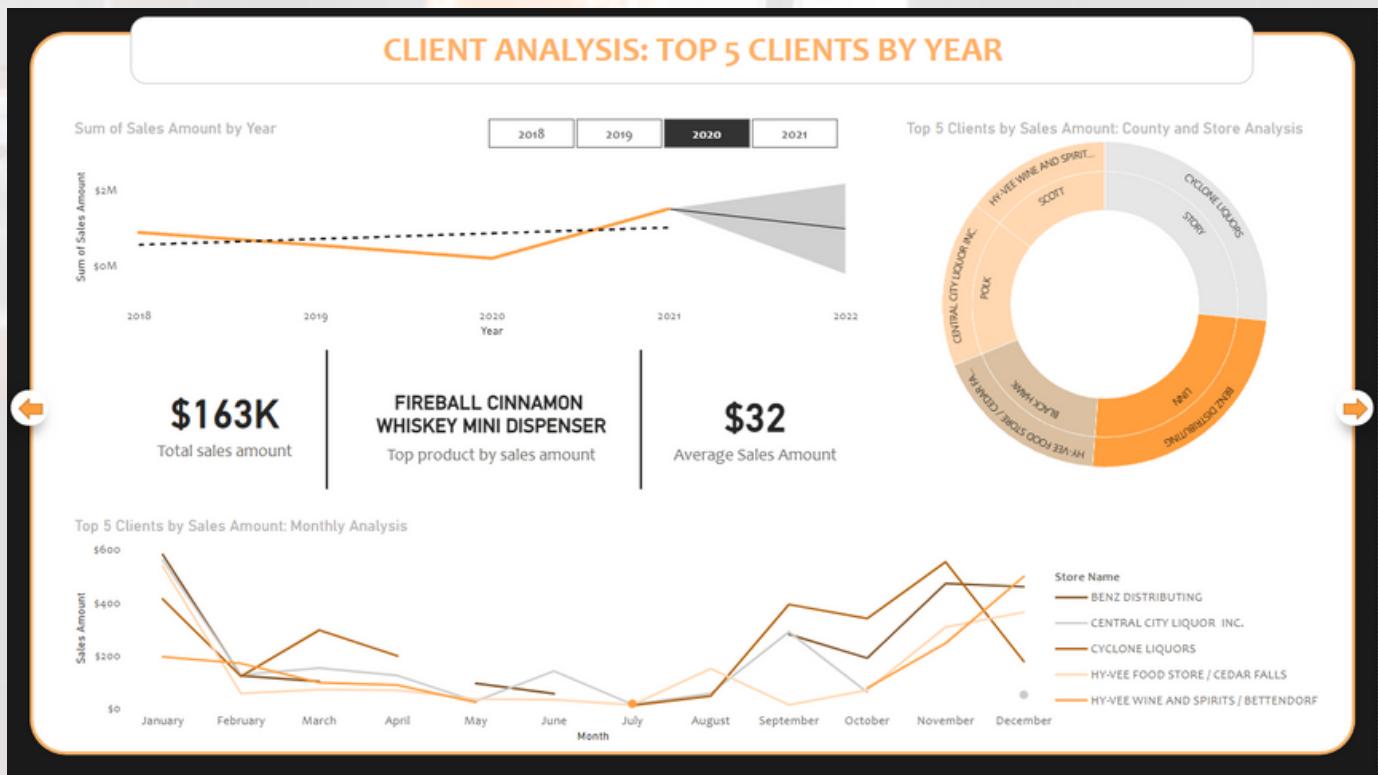


Figure 34 - Solution 1: BN4 Clients Analysis

For this answer this question we used:

- **Slicers** for the year selection
- We imported the **Sunburst v2.2.3** visualization to analyse the top 5 clients by sales amount
- **Cards** to display the total sales amount, the top product sold measuring the sales amount and the average sales amount.
- A **line Chart** to show a monthly analysis of the top 5 clients by sales amount
- A **Line Chart** where we enable the option of forecast in order to predict the next year of sales amount.

By utilizing these visuals we were able to analyse our top-performing clients and our most sold products based on the sales amount. With the slicers, we can select the specific year that we want to analyse and evaluate our performance.

The cards display information that serves as a quick reference point for key sales metrics. To track the monthly progress of our top 5 clients by sales amount, we inserted a line chart to allow us to identify trends and have a more intuitive look over our sales.

We decided to use the forecasting option in another line chart, predicting the sales amount for the upcoming year. This predictive analysis facilitates proactive planning and strategic decisions.

By providing these insights, we can better manage our client relationships by having in mind our most important clients, better manage our product portfolio and strengthen our overall sales productivity

SOLUTION 2

This solution was developed by importing the data from the DW directly into PBI.

To develop a new data model, the following steps were followed:

1. Import the data from the SQL Server database (DW)
2. **Hide unnecessary columns** for the report, such as the business key, surrogate key and the columns regarding the slowly-changing dimensions for the dimensions and foreign keys for the fact table. The date dimension is the only one that we do not hide the BK, known as Date since this column will be marked as a unique identifier for the date table.
3. **Rename the remaining columns** so that they are easier to understand. So, for every dimension and fact table, we capitalise each word and replace the underscore with a space.
4. **Check the data types and formats** of each column and configure them when needed.
5. **Sort the Month, Trimester and Semester** according to the number of columns so that they appear in the proper order, in the Date Dimension.
6. Configure the **hierarchies** for all dimensions.
7. In the fact table, create the **Calculated Column: Gross Margin Rate**:

```
Gross Margin Rate = DIVIDE([Sales Amount]-[Cost Amount], [Sales Amount], 0 )
```

8. Create the needed **calculated measures** once again (these measures are explained in more detail in section 4.4):

- **Sum of Sales Quantity**

```
Sum of Sales Quantity = SUM([Sales Quantity])
```

- **Sum of Sales Amount**

```
Sum of Sales Amount = SUM([Sales Amount])
```

- **Sum of Cost Amount**

```
Sum of Cost Amount = SUM([Cost Amount])
```

- **Sum of Profit Amount**

```
Sum of Profit Amount = SUM([Profit Amount])
```

- **Average of Sales Quantity**

```
Average of Sales Quantity = AVERAGE([Sales Quantity])
```

- **Average Sale Price**

```
Average Sale Price = DIVIDE([Sum of Sales Amount], [Sum of Sales Quantity], 0)
```

- **Gross Margin Percentage**

```
Gross Margin Percentage = DIVIDE([Sum of Sales Amount] - [Sum of Cost Amount], [Sum of Sales Amount], 0)
```

- **Sales Growth Rate**

```
Sales Growth Rate =
VAR CurrentYearSales = CALCULATE( SUM('Fact Sales'[Sales Amount]), 'Dim Date'[Year] = 2020)
VAR PreviousYearSales = CALCULATE( SUM('Fact Sales'[Sales Amount]), 'Dim Date'[Year] = 2019 )
RETURN DIVIDE( CurrentYearSales - PreviousYearSales, PreviousYearSales)
```

Additionally, we decided to create the two calculated measures below (not in the tabular model) for the purpose of improving the visualizations and content on the Profit Analysis:

- **Top 5 Profit**

Measure that calculates the total profit for the top 5 products:

```
Top 5 Profit = SUMX(TOPN(5, ALL('Dim Product'[Item]), [Sum of Profit Amount], DESC), [Sum of Profit Amount])
```

- **Top 5 Profit Percentage**

Measure that calculates the percentage of the top 5 products' profit compared to the total profit:

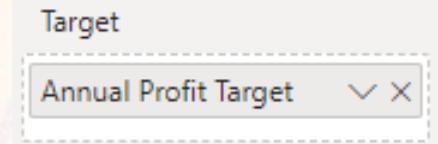
```
Top 5 Profit Percentage = [Top 5 Profit] / [Sum of Profit Amount]
```

- **Annual Profit Target - KPI**

To develop a visualization where we can analyse our **annual profit performance** it is necessary to establish a measure that defines the annual profit target, which is **450 000\$**.

With this metric defined, we can use it in the "target" container in the KPI visualization.

```
Annual Profit Target = 450000
```



After the steps above, a dashboard in Power BI that addresses various business needs and provides answers to related business questions was created. Each page of the dashboard addresses specific needs and provides valuable information. Below is an overview of the pages and their focus:

BN1 | SALES ANALYSIS

The "Category-Based Sales, Costs and Pricing Overview" answers the business questions below regarding the business need Sales Analysis:

- 1** Which months have the higher sales, per category, per month and per year?
- 2** How does the sales amount compare to the cost amount per product category over time?
- 3** On AVG what are the sale prices per category and subcategory (top 5), by semester?

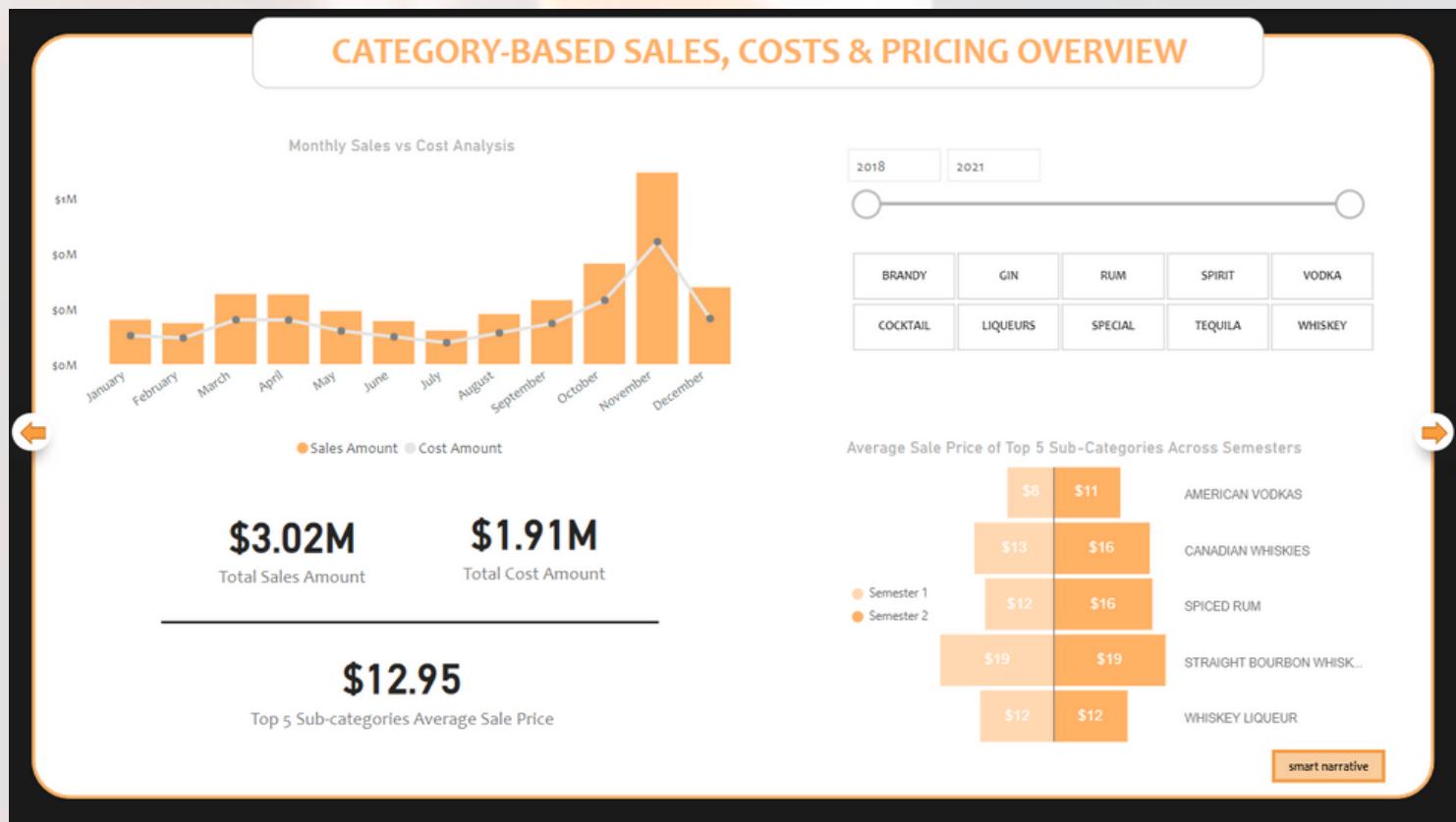


Figure 35 - Solution 2: BN1 Sales Analysis

In this page, the following visualizations were incorporated:

- **Slicers** for category and year selection.
- **Stacked line and column chart** to present sales performance and cost comparison over time, which helps in identifying trends and potential opportunities.
- **Cards** for key metrics regarding profitability, such as total sales and cost amount and the average sale price of the top 5 categories.
- We have imported the **Tornado 2.1.0 chart** to visualize price changes of the top 5 subcategories across semesters, which aids us in understanding pricing dynamics.

By analyzing the sales data, the report identifies the **months with the highest sales values, broken down by category and for each month and year**. This allows the business stakeholders to identify periods where sales peak and to monitor whether a particular product category has seasonality or fluctuations.

Additionally, the report **compares the sales amount with the cost amount throughout the year**, enabling a comparison between the revenue being generated against the costs being spent. Although this is related to profit, it provides insights of both revenue and costs separately.

Also, the report provides valuable information of pricing trends and helps to identify pricing patterns. Stakeholders can use this data to make informed decisions related to pricing strategies, product positioning or competitor analysis.

BN2 | VENDOR ANALYSIS

The "Top 5 Vendors with Least Orders per Trimester" answers the business question:

- Who are our 5 vendors with fewer orders, per trimester?

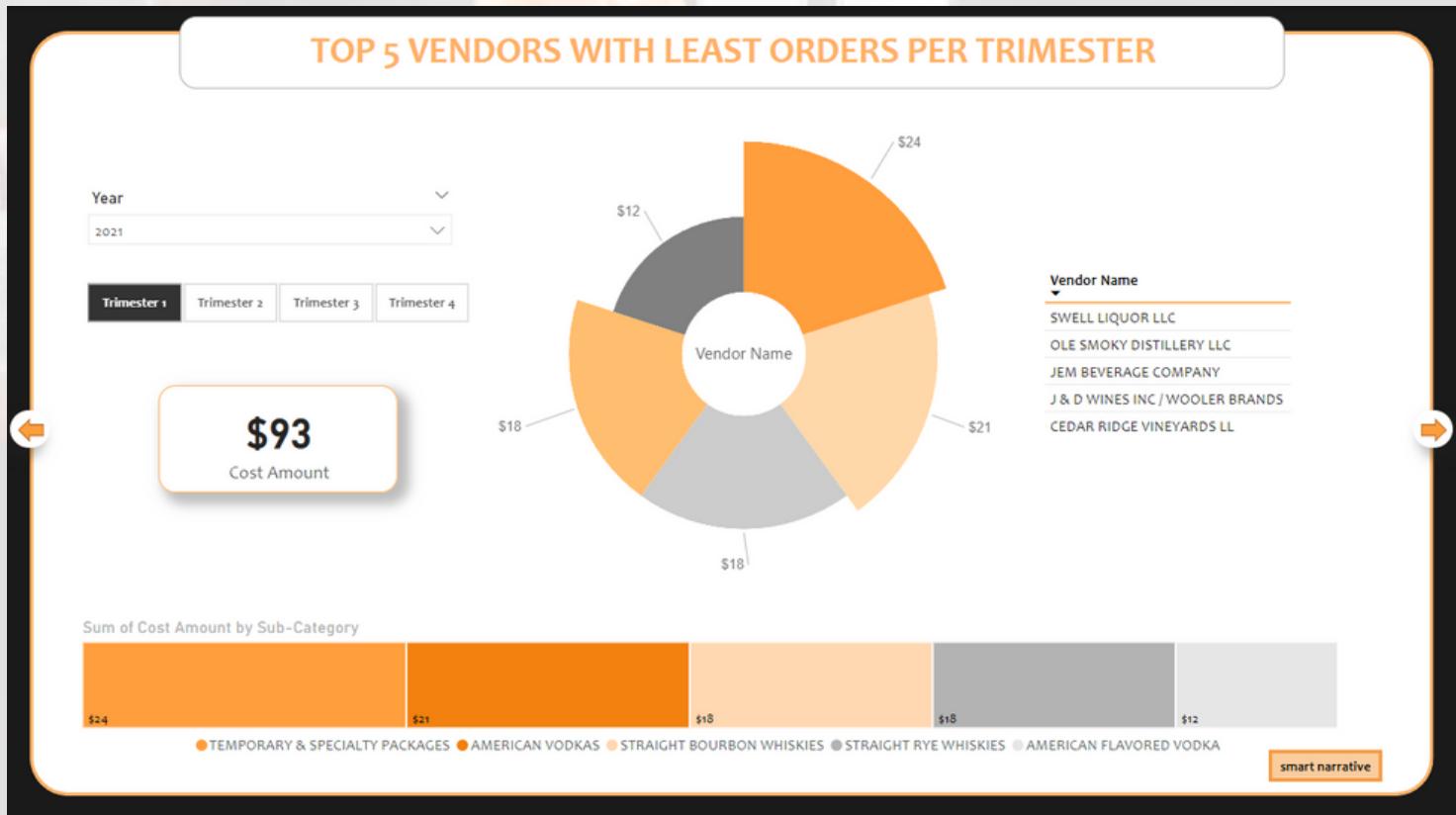


Figure 36 - Solution 2: BN2 Vendor Analysis

In terms of visualizations, the report incorporates the various elements below:

- **Year and Quarter Slicers** allowing stakeholders to filter and focus on desired time periods for analysis.
- A **card** visual is used to show the total cost amount associated with the selected time frame. This concise representation of cost enables a quickly identification of the overall expense for the given time period.

- A **treemap** is used to present the sum of the cost amounts in different subcategories. This visual element provides a hierarchical representation of the data and shows the importance of each subcategory in terms of expenses.
- The **imported Aster Plot 1.4.0 chart** focuses on showing the top 5 vendors with the lowest number of orders. This chart then displays the individual vendors and their corresponding order amounts.
- A **table** is added to present the names of the vendors with the fewest orders when the user interacts with the other visualizations, which allows quick identification of specific vendors in need of potential intervention.

This page offers valuable information on the vendors with the lowest number of orders, categorized by trimester. By looking at this data, we can see if any specific vendors require attention and, therefore, proactively address any underlying issues, establish a more effective communication channel, negotiate more favorable conditions, or consider alternative vendor options. This analysis ultimately allows us to better optimize our relationships with vendors, something essential for the success of the company.

BN3 | PROFITABILITY ANALYSIS

The "Annual Profit Dynamic & Top Performing Products Analysis" page answers the business questions below regarding the business need Profitability Analysis.

- 1 What are the top 5 products with higher profit, per year?**
- 2 What is the weight of our top 5 products on the overall profit?**
- 3 How did the profit change over the months and years?**

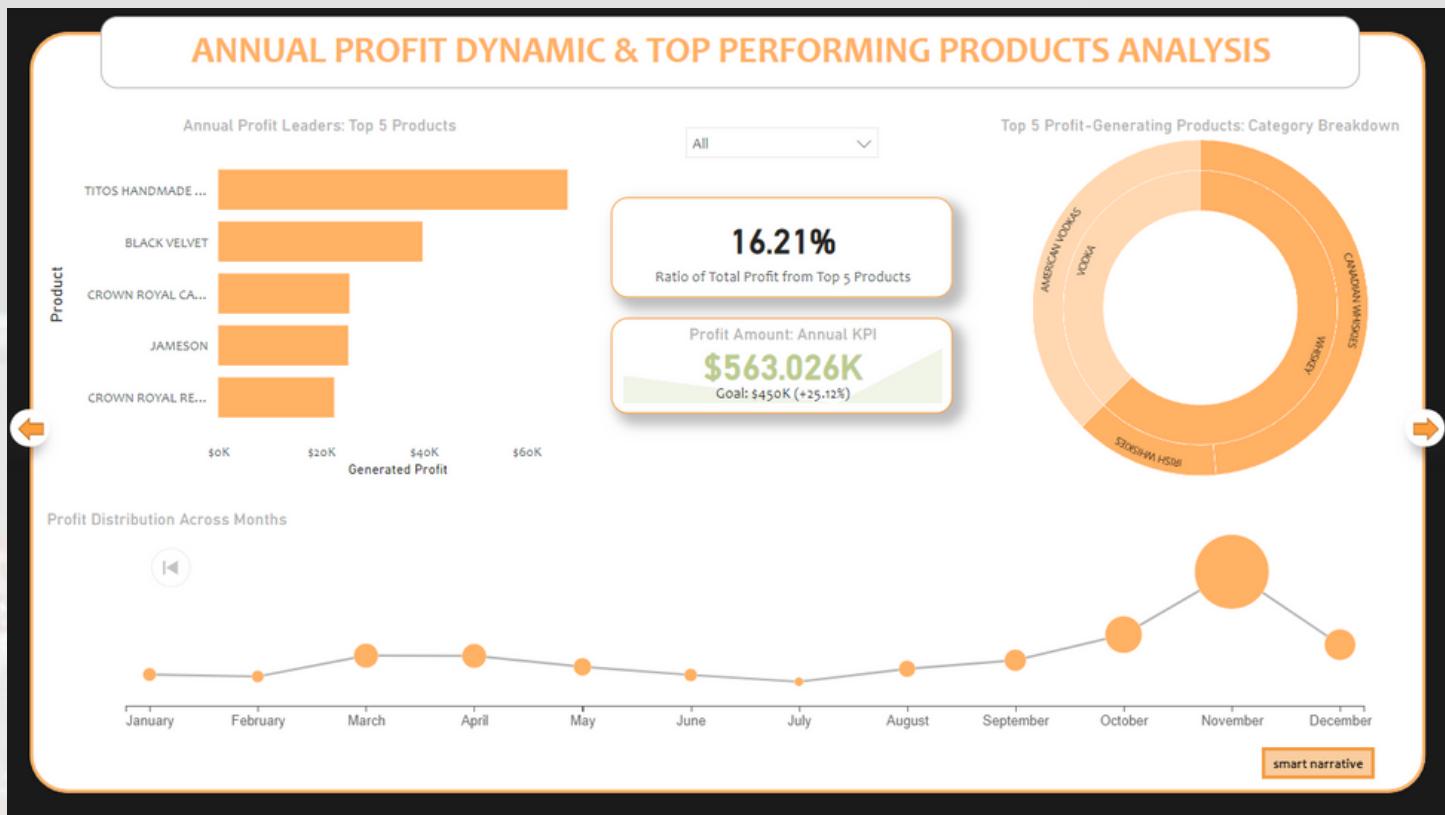


Figure 37 - Solution 2: BN3 Profitability Analysis

The report incorporates several visualizations:

- The **stacked bar chart** illustrates the profit created by the top 5 products in different years. This visualization allows stakeholders to compare and identify the leading products in terms of profitability over time.
- The **imported Sunburst v2.2.3 Chart** provides a hierarchical breakdown of the top 5 profit-generating products by showing how products are distributed across the different categories and which ones contribute more to the overall profit.
- The **imported LineDot chart 2.0.3** displays the distribution of profit over months, enabling interested parties to identify any patterns or trends in the profit variation over time. Such visualization helps understand seasonality or changes in profitability and supports informed decision making based on monthly profit information.

- A **card** visualization is used to depict the ratio of the total profit generated from the top 5 products. This provides a quick overview of the overall contribution of the major products to profitability.
- To enhance interactivity, a **slicer** is included to select the year, allowing stakeholders to focus on particular years and explore the dynamics of earnings in those periods.
- To measure our performance over the annual profit performance we also inserted a **KPI visualization**, where we can see the annual target, the current status and the temporal performance over time.

Overall, this page provides valuable information regarding the **best-performing products** based on profit, their **contribution to overall profit**, the **evolution of profit trends** over months and years and the **company's annual performance**

Also, this analysis helps the company understand product performance, identify successful product lines, and replicate potential strategies for future success.

Furthermore, the report assesses the weight of the top 5 products in the overall profit. By evaluating the contribution of these products to overall profit it's possible to gain a clear understanding of the importance of the top performing products on the company's profitability.

BN4 | CLIENTS ANALYSIS

The "Store Performance Analysis" page answers the business questions below regarding the business need Clients Analysis.

1 Which store has the highest order values, per city, per year?

2 Who are our top 3 clients, per category?

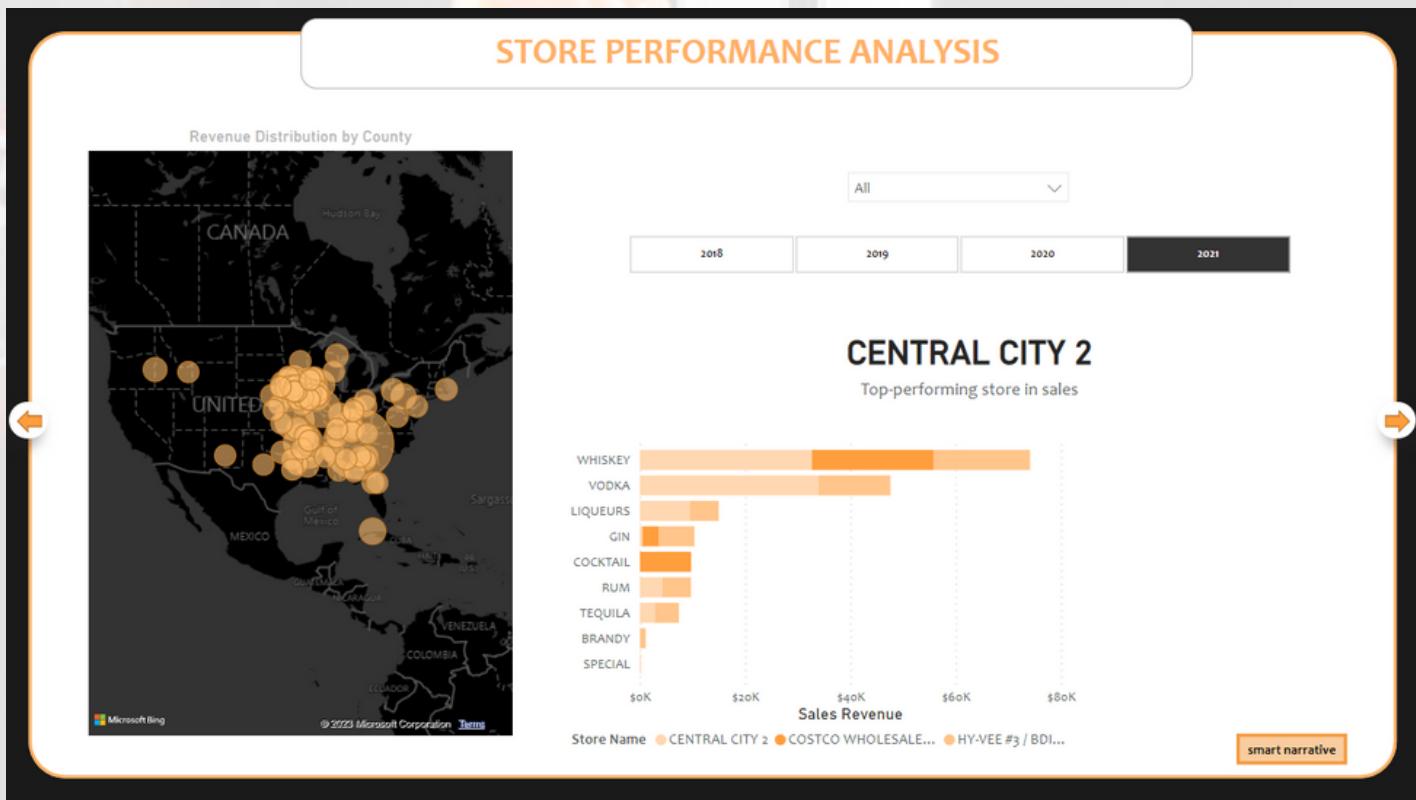


Figure 38 - Solution 2: BN4 Clients Analysis

Visualizations used:

- The **Map** Visualization displays the revenue generated by different counties, allowing geographical insights.
- The **Slicers for county and year selection** enable users to filter the data based on specific counties and years of interest.
- Furthermore, a **card** visualization is used to display the top-performing store, by county, based on sales. This concise representation highlights the store generating the highest sales.

- To analyze the top 3 clients per category, a **stacked bar chart** is employed. This visualization showcases the top 3 stores across different categories, providing a clear understanding of their performance and highlighting their significance within each category.

In conclusion, this solution provides insights regarding the geographical location of the best clients. Additionally, knowing the stores with the highest sales allows stakeholders to focus on its performance and potentially extract successful strategies for other stores.

Furthermore, this analysis enables stakeholders to identify the stores that are excelling in specific categories, which gives us the opportunity to optimize client engagement strategies accordingly.

Overall, this solution provides a thorough analysis of the business needs of the company, which enables stakeholders to gain valuable information so that they can make informed decisions, drive growth and success for the future.

5.5. POWER BI EXTRA DEVELOPMENTS

- Home Page and Navigation Buttons

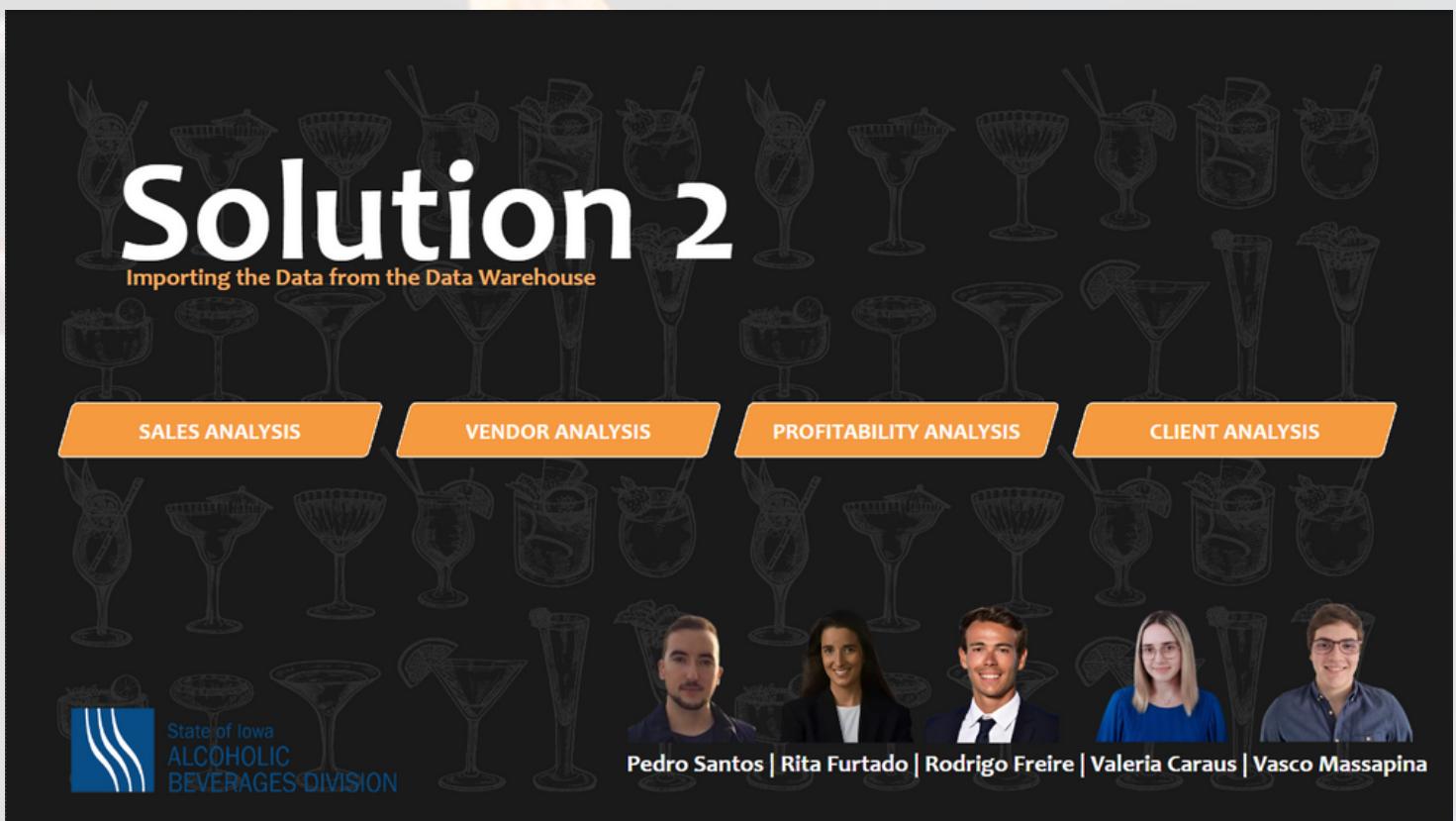


Figure 39 - Dashboard Home page

To improve our dashboard's usability and navigation, we decided to create a **"Home page"**. This introductory page provides a brief overview of the dashboard and simultaneously displays all the pages within it.

To create the home page, we **inserted an image** and "sent it to the back", on top of the image we **input a black rectangle with 10% of transparency** to ensure that the text and buttons on the top were readable. Then we incorporated a **page navigator** to allow the navigation directly to the page in need.

We did this addition with the goal transform our dashboard into a more intuitive, straight to the point and dynamic.



Figure 40 - Dashboard Navigation Arrows

We also inserted two arrows on each page to allow navigation to the next and previous pages in the dashboard.

We did this by inserting an arrow shape and enabling the option "action" and then we defined the action type as "page navigation" and then selected the correspondent page.

- **New visualizations imported**

To enrich our dashboard we searched for more appealing and appropriate visuals. All of our importations were made through the **Power BI visuals library**.

All the importations were mentioned before in the report.

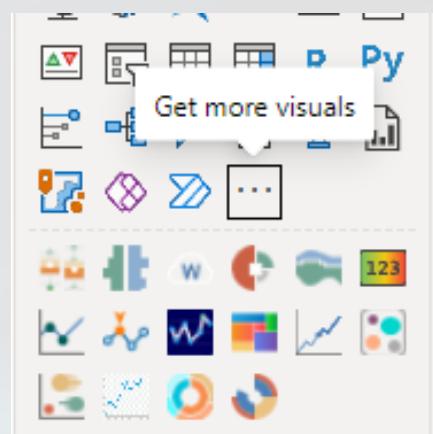


Figure 41 - Visuals Library

- **Forecast**

With the goal of more advanced data insights, we decided to utilize the **forecast option** in one of our visualizations. This enables predictive analysis, providing us with a peek into potential future trends based on our historical data. In our case, we used it to **forecast the sales amount for the next year**.

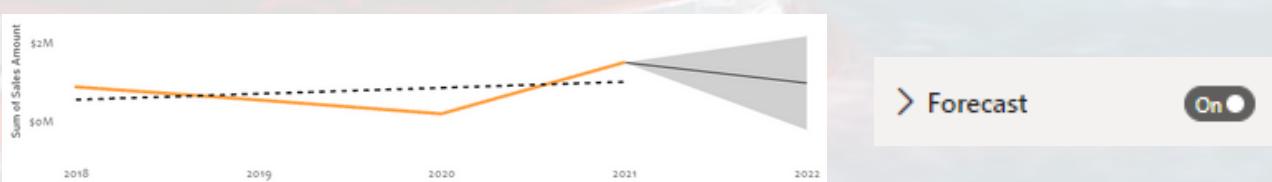


Figure 42 - Forecast option

- **Smart Narrative**

We decided to utilize the **smart narrative** feature. This feature uses AI to automatically generate a text that summarizes and explains the visualized data highlighting key points and trends, which makes it easier to understand complex data at a glance.

Nevertheless, considering the number of visualizations already on our dashboard, we felt adding the smart narrative directly could lead to information overload. Also, we decided that the make-it option was a better decision to let the user decide if he prefers a graphic-only dashboard or appreciated a "non-graphical" analysis as well.

To do this, we integrated an interactive button, activating the 'action' functionality. This button serves as a toggle switch to display or hides the Smart Narrative. We created this functionality using bookmarks; one bookmark was configured to hide the Smart Narrative, while another was set to display.

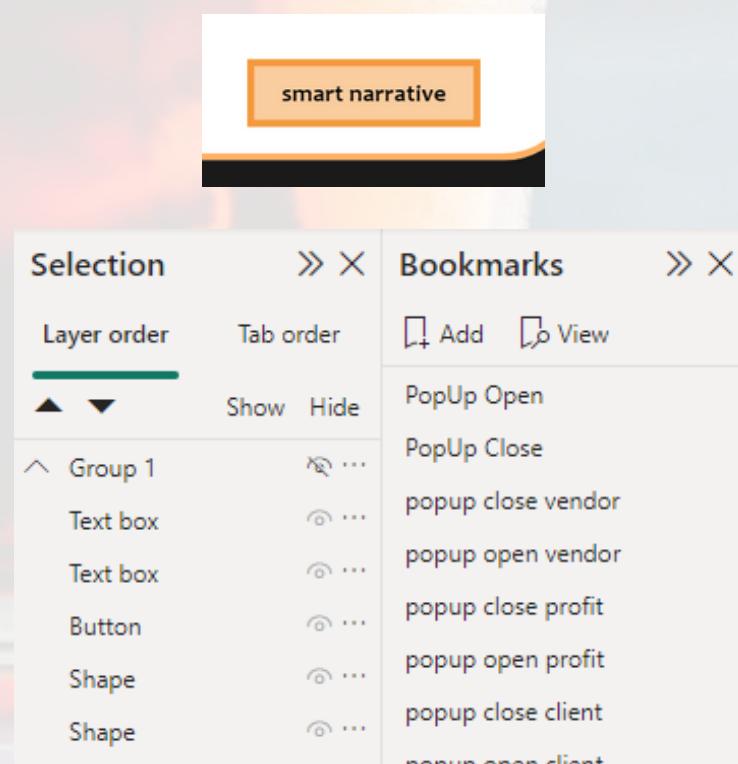
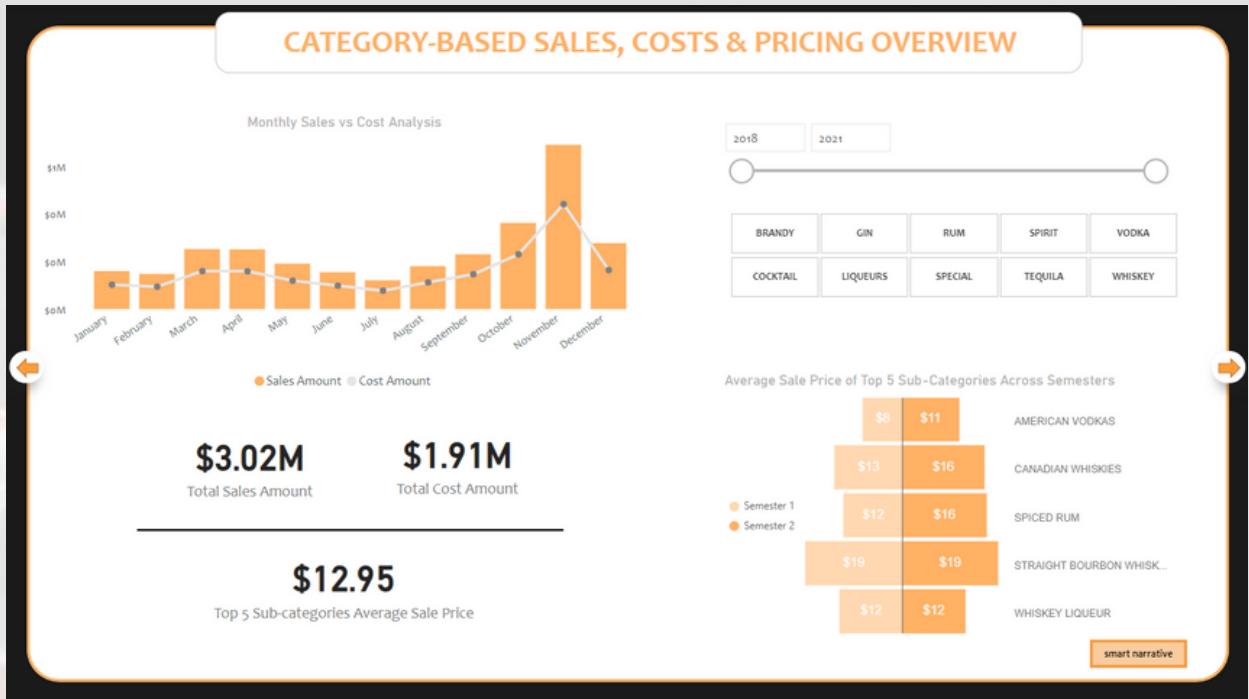


Figure 43 - Smart Narrative Feature Development

Smart Narrative Closed



Smart Narrative Open

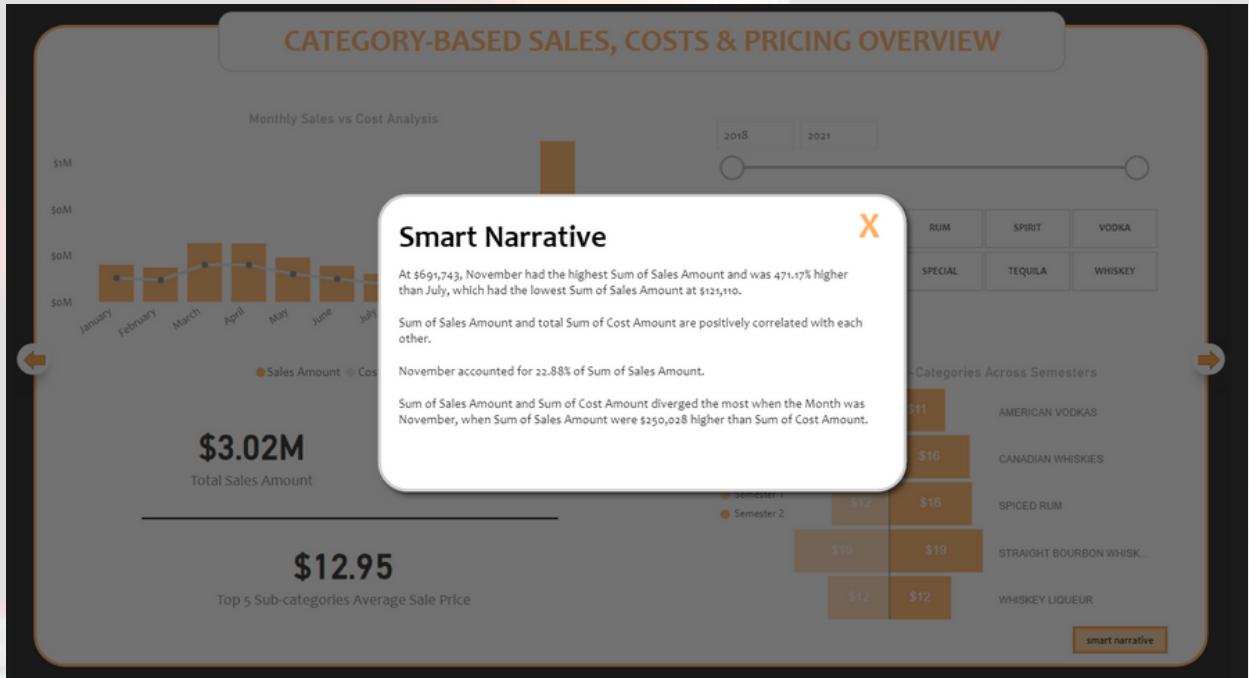


Figure 44 - Smart Narrative Visualization options

CRITICAL ASSESSMENT

Data continues to grow in size and significance, driving decision-making at all levels in an organisation. Therefore, the speed and effectiveness of the total business can be affected by how companies store, access, manage, and assess data.

In our assignment, we used a sample of the Kaggle database, so our analysis doesn't represent the real business. As we could conclude from the dashboard analysis, there are some values that do not make much sense and for which we have no explanation.

Moving on to a more critical evaluation of the process, we developed an OLAP tabular model to query, analyze and process the information stored in the Iowa Alcoholic Beverages Division data warehouse.

We were having an error when giving Deploy (running the solution) of SSAS in visual studio. After watching a video tutorial from the Professor we saw that it was a problem with one of the Windows settings, more precisely with the credentials, which did not let the program run. This issue was thus overcome.

Throughout the work, we were faced with some difficulties / more critical situations, related to the visual studio, such as:

- When making the reports, we were dragging the measures to the wizard and it was giving an error. Later we realized that we had to use the calculated measures (sum of sales amount and not the sales amount).
- Also in the reports part, initially we were having difficulties understanding how the issue of giving "group" to drill-downs, sorts and filters worked.

- Understanding the "parameters" was also one of the difficulties experienced. Initially, we had an error when giving display, we received a message that something in relation to the parameters format was wrong and we couldn't understand where the error was really coming from. This situation always happened with the parameter "year".

Another difficulty felt was sharing solutions from one computer to another. We noticed that if one of the parties has an incompatible version or different environment settings installed, it is difficult to open the work. And identifying where the error that prevents the work from being opened is another equally complicated and time-consuming process.

One of the things we learned while using Power BI, was that there is a vast possibility to create dashboards that fit our needs. We had difficulty doing the forecast because not all graphs had this possibility. However, our learning curve in Power BI was growing as we came up with an idea and tried to develop it, because as we tried to do one thing we discovered a lot of extra options. We realized that there are certain types of visualizations that are better suited to the different types of questions that we want to answer.

To conclude our critical assessment, Power BI is a powerful tool regarding power query, data modelling, smart formulas and data visualisation with advanced interactive capabilities and extensive connectivity to databases.

CONCLUSIONS

In conclusion, the extensive analysis that was carried out about the **Iowa Alcoholic Beverage Division's** sales, vendors, profitability and clients provided business insights that can shape the company's overall strategy and drive growth.

The in-depth exploration of the data unveiled major trends, patterns and opportunities for the company, enabling informed decision-making. Below are some of the key findings and conclusions that can be inferred from the report:

- **Sales analysis:** Identifying top-selling products, locations and sales trends across different time periods enables the company to optimize the categories with the highest demand and adjust its marketing strategies accordingly. This information also reveals poor performance areas where we can implement specific actions to improve sales and profitability.
- **Vendor analysis:** Evaluating each vendor's cost of goods sold will help us identify which are our top vendors by category, semester and year. Knowing this information is crucial since we can optimize relationships with our best vendors or terminate relationships with those that are no longer profitable.
- **Profitability analysis:** Being able to assess the profitability of our products, including identifying the most and least profitable products by category, subcategory, and location, allows us to make data-driven decisions about whether or not to offer new products, as well as how to improve our product portfolio and whether we can expand into new geographies.
- **Client Analysis:** Identifying our top stores in each city and county, by category and subcategory, provides us with the ability to understand what we are doing well with this client so that we can improve with others. Also, we can explore potential partnerships and consequently prioritize our resources and strengthen our relationships with our clients.



On a general note, all of the analysis performed has given the company a strong foundation for data-driven decision making. Taking advantage of this information allows the company to optimize transactions, improve its strategies, and foster long-term growth. Therefore, the need to continuously monitor key performance indicators and adapt strategies to the evolving market dynamics is imperative. By leveraging data-driven approaches, we can secure a competitive advantage, meet market expectations and achieve long-term success in the beverage industry.